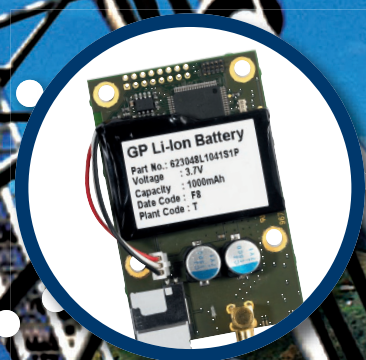


Grundfos CIM 250

GSM for Grundfos Dedicated Controls

GB Functional profile and user manual



CONTENTS

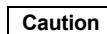
	Page
1. Symbols used in this document	2
2. Introduction	2
2.1 About this functional profile	2
2.2 Assumptions	2
2.3 Definitions and abbreviations	2
2.4 System diagram	3
2.5 Specifications	4
3. CIM 250 GSM module	5
3.1 Installation	5
3.2 LEDs	7
4. Modbus function code overview	7
5. Functional profile	8
5.1 Register block overview	8
5.2 CIM configuration register block	8
5.3 CIM status register block	9
5.4 Pit control and configuration register block	10
5.5 Pit status register block	12
5.6 Pit data register block	16
5.7 Pump 1 – data and status module register block	17
5.8 Pump 2 – data and status module register block	19
5.9 Simulation register block	20
5.10 User register block	20
5.11 Name string register block	20
5.12 Hour log register block	21
5.13 Event log register block	22
5.14 Data log index	23
5.15 Data log series	24
6. Detailed descriptions	25
6.1 SCADA PIN code protection	25
6.2 Reading the event log	25
6.3 Reading the configurable data log series	25
6.4 Separation of reads and writes	26
6.5 Control bit acknowledgement	26
6.6 GSM call-up connection	27
6.7 GSM call-back connection	27
6.8 Use of SMS messages	28
6.9 GPRS connection	29
6.10 Interlocking	32
6.11 Real-time clock	34
6.12 Event simulation	34
6.13 Alarms and warnings	35
7. Commissioning	37
7.1 Step-by-step guide to hardware setup (CIM 250)	37
7.2 Quick guide to communication	37
8. Fault finding	38
8.1 LED status	38
8.2 Modbus GSM/GPRS communication faults	39
9. Data item overview	40
10. Grundfos alarm and warning codes	46
11. Modbus telegrams and function codes	48
11.1 Modbus telegram overview	48
11.2 Modbus function code overview	48
11.3 Read holding registers (0x03)	49
11.4 Read input registers (0x04)	49
11.5 Write single register (0x06)	49
11.6 Write multiple registers (0x10)	50
11.7 Diagnostics (0x08)	51
11.8 Diagnostics register interpretation	52
12. Application example	53
12.1 Adaptation of pit graphics to installation values	54
12.2 Main status	54
13. Modbus telegram examples	58
13.1 Diagnostics: return query data	58
13.2 Reading the device configuration register block	58
13.3 Reading the pit water level	58
13.4 Reading the pit alarms	59
13.5 Setting pit auto mode	59
13.6 Interlocking the pit	59

1. Symbols used in this document

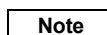


Warning

If these safety instructions are not observed, it may result in personal injury!



If these safety instructions are not observed, it may result in malfunction or damage to the equipment!



Notes or instructions that make the job easier and ensure safe operation.

2. Introduction

2.1 About this functional profile

This functional profile describes the CIM 250 (GSM/GPRS Communication Interface Module) for the Grundfos Dedicated Controls CU 361 control unit.

The data in this document are subject to change without prior notice. Grundfos cannot be held responsible for any problems caused directly or indirectly by using information in this functional profile.

2.2 Assumptions

This functional profile assumes that the reader is familiar with commissioning and programming Modbus devices. The reader should also have some basic knowledge of the Modbus protocol and technical specifications.

2.3 Definitions and abbreviations

0b	Prefix "0b" indicates a binary number.
0x	Prefix "0x" indicates a hexadecimal number.
APN	Access Point Name. Name used to identify a GPRS service in the GSM mobile network.
CIM 250	Grundfos Communication Interface Module.
CRC	Cyclic Redundancy Check. A data error detection method.
CSD	Circuit Switched Data. Connection is established via a fixed connection (a physical circuit or a reserved data channel).
CU 361	Grundfos Control Unit for Dedicated Controls.
GENIbus	Proprietary Grundfos fieldbus standard.
GPRS	General Packet Radio Service.
GRE	Generic Routing Encapsulation. A tunnelling protocol that can encapsulate a TCP packet type inside IP address tunnels, creating a virtual point-to-point link between routers at remote points over the internet.
GSM	Global System for Mobile communications.
IO 111	Grundfos protection module.
IO 351	Grundfos I/O module.
LAN	Local Area Network.
LED	Light-Emitting Diode.
Modbus	A fieldbus used worldwide.
MP 204	Grundfos Motor Protector.
PIN	Personal Identification Number (SIM cards).
PUK	Personal Unblocking Key (SIM cards).

SELV	Separated or Safety Extra-Low Voltage.
SELV-E	Separated or Safety Extra-Low Voltage with Earth connection.
SIM	SIM card, Subscriber Identity Module.
SM 111	Grundfos Sensor Module for integration in pumps (using powerline communication interface).
SMA	SubMiniature version A. Coaxial radio signal connection standard.
TCP/IP	Transmission Control Protocol/Internet Protocol. Protocol suitable for internet communication.
Transmission speed	Bits transferred per second.
UTF-8	Unicode Transformation Format (character encoding).
VPN	Virtual Private Network. A network using the internet to connect nodes. These systems use encryption and other security mechanisms to ensure that only authorised users can access the network and that the data cannot be intercepted.

2.4 System diagram

The CU 361 control unit is connected to one or two Grundfos wastewater pumps. It offers status information as well as control and monitoring of a wastewater pit via a user-friendly control panel with display.

The CIM 250 is an add-on communication module to be fitted in the CU 361, using a 10-pin connection. This enables GSM/GPRS communication with a PLC, SCADA system, mobile phone, etc.

Via the GSM/GPRS connection, it is possible to control the pumps and read status, measured values, logs, etc.

CU 361 with CIM 250 GSM module

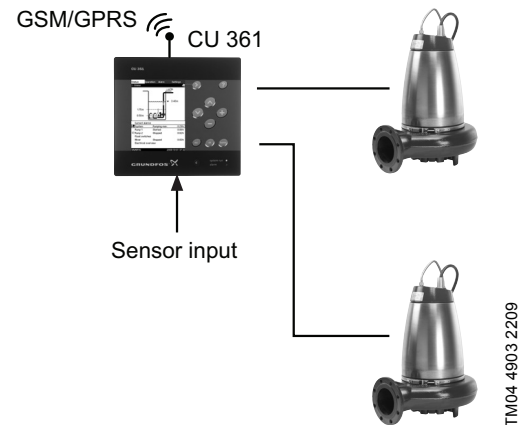


Fig. 1 CIM 250 solution for CU 361

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2.5 Specifications

The table below gives an overview of the specifications for the Grundfos CIM 250. For further details, please refer to the specific sections of this functional profile.

General data	Description	Comments
Ambient humidity	30 % to 95 %	Relative, non-condensing.
Battery, lithium-ion	The battery will only be charged if the battery temperature is within 0 °C to +45 °C.	
GENIbus visual diagnostics	LED2	Off, permanently green, flashing red, permanently red. See section 3.2 LEDs .
Modbus GSM/GPRS specifications		
Data protocol	Modbus RTU/Modbus TCP	
Modbus connection type	GSM/GPRS	
Slave address	Factory 231 (0xE7)	
GSM/GPRS visual diagnostics	LED1	Off, flashing green, flashing red, permanently red. See section 3.2 LEDs .
Maximum Modbus telegram size	256 bytes	Node address and CRC included.

3. CIM 250 GSM module

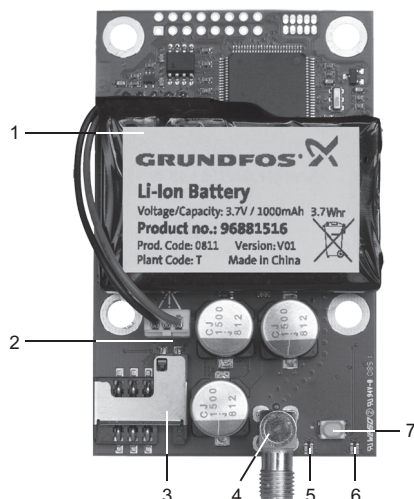


Fig. 2 CIM 250 GSM module (top side view)

Pos.	Designation	Description
1		Rechargeable lithium-ion battery
2		Battery socket
3		SIM card holder
4		SMA connection for GSM aerial
5	LED1	Yellow/green status LED for GSM/GPRS communication
6	LED2	Red/green status LED for internal communication between the CIM 250 and the CU 361
7	SW1	Reset button (has no function for the CU 361)

3.1 Installation

Note

Before installation, make sure that the power supply has been switched off and that it cannot be accidentally switched on.

3.1.1 Fitting a GSM aerial

The aerial supplied with the CIM 250 must be connected to the CIM 250 to establish connection to the GSM network.

Note

If the CIM 250 is installed in a metal control cabinet, Grundfos recommends to fit an external GSM aerial.

External aerial

See fig. 3.

Connect the aerial cable to the SMA connection (pos. 1) of the CIM 250. The aerial must be installed outside the control cabinet in a position with good reception conditions.

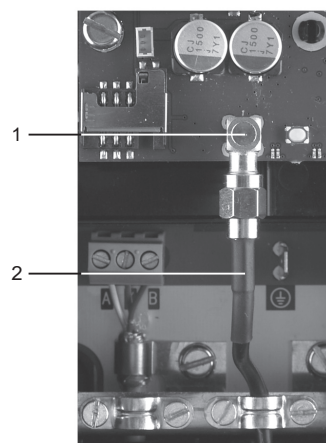


Fig. 3 Fitting an external GSM aerial

Pos.	Description
1	SMA connection for GSM aerial
2	Aerial cable for external GSM aerial

3.1.2 Inserting the SIM card

Procedure

1. Insert the SIM card into the CIM 250. See fig. 4.

Note

The slanted edge of the SIM card must point downwards.

The connectors on the SIM card must point downwards towards the CIM 250. See fig. 4.

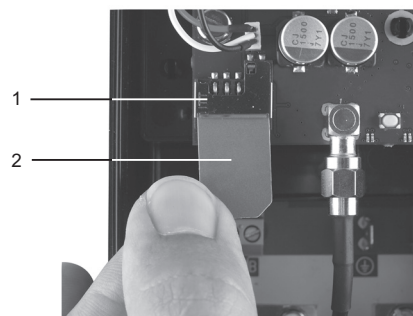


Fig. 4 Inserting the SIM card

Pos.	Description
1	SIM card holder
2	SIM card

2. Enter the correct PIN and PUK codes on the CU 361 control panel. See installation and operating instructions for Dedicated Controls.

To find the parameter in the CU 361, go to Settings > Communication settings > SIM card settings.

Note

The CIM 250 must be selected in the Settings menu "Communication settings" before the "SIM card settings" submenu becomes available.

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3.1.3 Connecting the battery and power supply



Warning

The CIM 250 must only be connected to SELV or SELV-E circuits.



Warning

The safety precautions listed below must be observed carefully as improper handling of the lithium-ion battery may result in injury or damage from electrolyte leakage, heating ignition or explosion.

These safety precautions must be observed:

- Only insert the approved Grundfos battery pack (96881516).
- Never use this battery pack in other battery chargers.
- Do not dismantle or modify the battery.
- Do not heat or incinerate the battery.
- Do not pierce, crush or cause mechanical damage to the battery.
- Do not short-circuit the battery.
- Do not allow the battery to get wet or be immersed in water.
- Do not strike or throw the battery.
- For long periods of storage, the temperature should be below 45 °C.

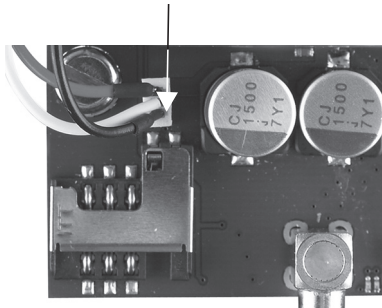
The CIM 250 is fitted with a lithium-ion battery. It is secured by a velcro strap which absorbs vibrations and makes it easier to replace the battery. Connect the battery to the CIM 250 as shown in fig. 5.

Note

If the battery is not connected, the user will not receive any SMS alarm message in case of a power cut.

Note

If the CU 361 has a backup battery, the CIM 250 will be able to send SMS alarm messages until the backup battery has been discharged.



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Fig. 5 Connecting the battery

Note

The battery will only be charged if the battery temperature is within 0 °C to +45 °C.

Switch on the power supply. The CIM 250 is powered either by the CU 361 or by the battery.

The LED1 is flashing yellow (searching for GSM network). When the connection to the GSM network has been established, the LED1 will pulsate yellow (GSM network active). See fig. 6.

The LED2 is permanently green (internal communication between the CIM 250 and the CU 361 is OK).

For setting up the CIM 250 for SMS functions, SCADA communication and interlock functions, see installation and operating instructions for Dedicated Controls.

To find the parameter in the CU 361, go to Settings > Communication settings >

- SMS numbers
- SMS schedule
- SMS heartbeat message
- SMS authentication
- SCADA settings
- Interlock settings
- GPRS settings.

3.2 LEDs

The CIM 250 GSM module has two LEDs.

See fig. 2.

- Yellow/green status LED (LED1) for GSM/GPRS communication
- Red/green status LED (LED2) for internal communication between the CIM 250 and the CU 361.

LED1 (yellow/green)

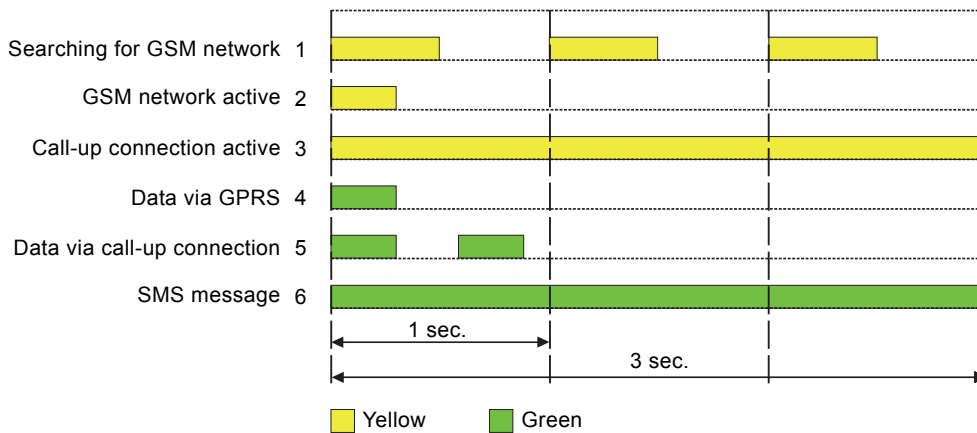


Fig. 6 LED1 status

Pos.	Status	Description
1	Flashing yellow.	Searching for GSM network.
2	Pulsating yellow (single pulse).	Connection to the GSM network has been established.
3	Permanently yellow.	Call-up connection has been established.
4	Pulsating green (single pulse).	Data are exchanged via GPRS.
5	Pulsating green (double pulse).	Data are exchanged via the call-up connection.
6	Green (3 sec.).	Sending or receiving an SMS message.

LED2 (red/green)

Status	Description
Off.	The CIM 250 has been switched off.
Flashing red.	No internal communication between the CIM 250 and the CU 361.
Permanently red.	The CIM 250 does not support the CU 361.
Permanently green.	Internal communication between the CIM 250 and the CU 361 is OK.

Note The CU 361 must have finished its start-up sequence before the LED2 can be used for status. This means that a certain delay may occur before the LED2 turns green after start-up of the CU 361.

4. Modbus function code overview

The supported function codes are shown in the table below:

Type	Code	Hex	Name
16-bit data (registers)	03	0x03	Read holding registers
	04	0x04	Read input registers
	06	0x06	Write single register
	16	0x10	Write multiple registers
Diagnostics	08	08	Diagnostics See section 11.7 Diagnostics (0x08) for subcodes.

Note Reading or writing coils are not supported.

The same data are available in both holding registers and input registers, meaning that either function (0x03 or 0x04) can be used for reading data.

5. Functional profile

5.1 Register block overview

The Modbus RTU registers are grouped in the following register blocks:

Starting address	Register block	Permission	Description
00001	CIM Config	R/W	Configuration of the CIM module.
00021	CIM Status	R	Status registers for the CIM module.
00101	Pit Control & Configuration	R/W	Registers for control and configuration of wastewater pit.
00201	Pit Status	R	Registers for status from wastewater pit.
00301	Pit Data	R	Registers for measured values from wastewater pit.
00401	Pump 1	R	Registers containing pit pump 1 data and status.
00451	Pump 2	R	Registers containing pit pump 2 data and status.
00701	Simulation	R/W	Features for simulation of alarms and warnings.
00751	User Registers	R/W	Registers where the user can freely store data.
00801	Name String	R	For reading the name string from the CU 361.
02001	Hour Log	R	Registers containing 72-hour logs.
06001	SCADA Event Log	R	Registers containing the latest 50 event log entries.
07001	Data Log Index	R	Index for the configurable data log series.
07301	Data Log Series	R	Configurable data log series.

All addresses contain registers. Some are bit-interpreted while others are 16-bit values, or part of 32-bit values. A data value of 65535 (0xFFFF) indicates "not available" when reading registers. The value 65535 (0xFFFF) does not imply a "disable" when writing values. Each register block will be specified in more detail in the following sections.

5.2 CIM configuration register block

Registers in this block can be read by means of function codes 0x03 and/or 0x04. They can be written as holding registers with function codes 0x06 and 0x10.

Address	Register name	Description
00001	SlaveMinimumReplyDelay	The minimum reply delay from the slave in ms. Value range: 0-10000, i.e. up to 10 seconds reply delay. This delay is typically used in conjunction with a modem. The delay value is stored in the device, and will remain after a power-off. The delay set here will be added to the internal delay in the device. Default value is 0.
00002	RESERVED	–
00003	SetModbusAddress	Modbus address (1-247). The value is stored in the device, and will remain after a power-off. Default value of this register is 0xE7 (231). The value can be written and changed to another value. As long as the address is 231, the CIM 250 will reply to all addresses used in a request.
00004	RESERVED	–
00005	AutoAckControlBits	Used to select the behaviour of control bit acknowledgements from the CIM 250. 0 = Disabled. Control bits are not automatically lowered when accepted by the device. The user must lower the triggered control bit manually before the control bit can be triggered again. 1 = Enabled. Control bits are automatically lowered when accepted by the device. The user does not have to lower it manually (default).
00006	ReadWriteSeparation	Used to select value read-back behaviour. The value in this register is stored in the device, and will remain after a power-off. 0 = Register values can be written by both the Modbus master and the CIM 250 (default). 1 = Read-backs are put into separate registers by the CIM 250, hence separating inputs from outputs. See section 6.4 <i>Separation of reads and writes</i> .
00007	ScadaGprsCallBackRegister	Used to select the register in the SCADA system that will be written when a call-back request is sent via GPRS. See section 6.9.5 <i>Call-back via GPRS</i> .

5.3 CIM status register block

Registers in this block can be read by means of function codes 0x03 and/or 0x04. They are read-only. This block can be used for various kinds of fault finding.

Address	Register name	Description
00021	GENIbusCRCErrorCnt	Holds a CRC error counter for the GENIbus connection to the CU 361.
00022	GENIbusDataErrorCnt	Holds a data error counter for the GENIbus connection to the CU 361.
00023	VersionNumber	A Grundfos-specific version number. This is an unsigned integer value.
00024	ActualModbusAddress	Holds the current Modbus slave address of the device. Valid value range: 1...247.
00025	GENIbusTXcountHI	Holds a transmit counter for total number of telegrams sent to the CU 361 on the GENIbus connection.
00026	GENIbusTXcountLO	
00027	GENIbusRXcountHI	Holds a receive counter for total number of telegrams received from the CU 361 on the GENIbus connection.
00028	GENIbusRXcountLO	

5.4 Pit control and configuration register block

Registers in this block can be read by means of function codes 0x03 and/or 0x04. They can be written as holding registers with function codes 0x06 and 0x10.

Address	Register name	Scale	Description
00101	PitControl Bit 0: ResetAlarm	bool	Control bit that resets alarms and warnings from the CU 361. 0 = No resetting 1 = Resetting fault. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section 5.2 CIM configuration register block address 00005 for acknowledgement behaviour.
	PitControl Bit 1: RESERVED	–	–
	PitControl Bit 2: ResetEventLog	bool	Control bit that resets the SCADA event log in the CU 361. 0 = No resetting 1 = Resetting event log. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section 5.2 CIM configuration register block address 00005 for acknowledgement behaviour.
	PitControl Bit 3: InterlockPit	bool	Control bit that interlocks the pit (stops all pumps) for a specified time interval (see the InterlockTimeout register 00226), meaning that the pit will automatically go back to "Auto" mode after timeout. 0 = No command 1 = Pit interlocked (status is read from OperatingMode, register 00203). This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section 5.2 CIM configuration register block address 00005 for acknowledgement behaviour.
	PitControl Bit 4: AutoPit	bool	Control bit that sets the pit to "Auto" mode. 0 = No command 1 = Pit in "Auto" mode (status is read from OperatingMode, register 00203). This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section 5.2 CIM configuration register block address 00005 for acknowledgement behaviour.
00102	PitControl Bit 5: CallBackAck	bool	Control bit that acknowledges a call-back from the CU 361. 0 = No command 1 = Acknowledging the call-back. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section 5.2 CIM configuration register block address 00005 for acknowledgement behaviour.
	RelayControl Bit 0: SetCustomRelay	bool	Control bit that sets the value of the custom relay. 0 = Relay state logical 0 1 = Relay state logical 1.
00103	PitPump1control	enum	Remote manual control of pump 1 in the pit. 0 = "Auto" mode (the pump is controlled by the pit controller) 1 = Forced start 2 = Forced stop.
00104	PitPump2control	enum	Remote manual control of pump 2 in the pit. 0 = "Auto" mode (the pump is controlled by the pit controller) 1 = Forced start 2 = Forced stop.
00105- 00108	RESERVED RANGE	–	–
00109	ScadaPinCode	unscaled	PIN code for SCADA systems, etc. If StatusRegister.ScadaPinCodeEnabled (register 00202, bit 4) is enabled, the correct PIN code must be set in this register in order to gain access to remote control and configuration. Verify acceptance in PitStatus.WriteAccess (register 00202, bit 5).
00110	SetEventLogClearID	unscaled	Selects which records to clear in the event log. Used together with ResetEventLog control bit (register 00101, bit 2).
00111	SetInterlockTimeout	1 min.	Interlock timeout value measured in minutes. Status of this register is read in InterlockTimeout (register 00226).
00112	SetRealTimeClockHI	1 second	Setting the real-time clock in the CU 361 in seconds since midnight January 1st 1970 (UNIX time).
00113	SetRealTimeClockLO		Set SetRealTimeClockHI and SetRealTimeClockLO in order to set a new time in UNIX format.
00114	SetRtcSecond	1 second	Real-time clock: Second of the minute [0; 59].
00115	SetRtcMinute	1 min.	Real-time clock: Minute of the hour [0; 59].
00116	SetRtcHour	1 hour	Real-time clock: Hour of the day [0; 23].
00117	SetRtcDay	1 day	Real-time clock: Day of the month [1; 31].
00118	SetRtcMonth	1 month	Real-time clock: Month of the year [1; 12].

Address	Register name	Scale	Description
00119	SetRtcYear	1 year	Real-time clock: Year [0; 254] = [year 2000; year 2254].
00120	SetRtc Bit0: SetRtc	bool	Control bit that sets the new real-time clock in the CU 361. 1 = Set new real-time clock from the registers 00114-00119. This control bit is triggered on rising edge only, i.e. setting logical 0 to 1. See section 5.2 <i>CIM configuration register block</i> address 00005 for acknowledgement behaviour.
00121	SetOverflowLevel	0.01 m	Setting a new level for activation of overflow level alarm. If ReadWriteSeparation (register 00006, bit 0) is set to '0', the CIM 250 will overwrite this register value with the resulting level.
00122	SetHighLevel	0.01 m	Setting a new level for activation of high-level alarm. If ReadWriteSeparation (register 00006, bit 0) is set to '0', the CIM 250 will overwrite this register value with the resulting level.
00123	SetAlarmLevel	0.01 m	Setting a new level for activation of alarm level alarm. If ReadWriteSeparation (register 00006, bit 0) is set to '0', the CIM 250 will overwrite this register value with the resulting level.
00124	SetDryRunningLevel	0.01 m	Setting a new level for activation of dry-running alarm. If ReadWriteSeparation (register 00006, bit 0) is set to '0', the CIM 250 will overwrite this register value with the resulting level.
00125	SetFoamDrainingLevel	0.01 m	Setting a new level for foam-draining stop. If ReadWriteSeparation (register 00006, bit 0) is set to '0', the CIM 250 will overwrite this register value with the resulting level.
00126	SetStartLevelPump1	0.01 m	Setting a new start level for the first pump. If ReadWriteSeparation (register 00006, bit 0) is set to '0', the CIM 250 will overwrite this register value with the resulting level.
00127	SetStopLevelPump1	0.01 m	Setting a new stop level for the first pump. If ReadWriteSeparation (register 00006, bit 0) is set to '0', the CIM 250 will overwrite this register value with the resulting level.
00128	SetStartLevelPump2	0.01 m	Setting a new start level for the second pump. If ReadWriteSeparation (register 00006, bit 0) is set to '0', the CIM 250 will overwrite this register value with the resulting level.
00129	SetStopLevelPump2	0.01 m	Setting a new stop level for the second pump. If ReadWriteSeparation (register 00006, bit 0) is set to '0', the CIM 250 will overwrite this register value with the resulting level.

5.5 Pit status register block

Registers in this block can be read by means of function codes 0x03 and/or 0x04. It is not possible to write to these registers.

Address	Register name	Scale	Description
00201	AcknowledgeRegister Bit 0: AckResetAlarm	bool	Indicates if a ResetAlarm control bit was acknowledged by the device. This bit is only active if AutoAckControlBits (register 00005, bit 0) is set to '0'. 0 = Not acknowledged 1 = Acknowledged.
	AcknowledgeRegister Bit 1: AckSetRtc	bool	Indicates if a SetRtc (real-time clock) control bit was acknowledged by the device. This bit is only active if AutoAckControlBits (register 00005, bit 0) is set to '0'. 0 = Not acknowledged 1 = Acknowledged.
	AcknowledgeRegister Bit 2: AckResetEventLog	bool	Indicates if a ResetEventLog control bit was acknowledged by the device. This bit is only active if AutoAckControlBits (register 00005, bit 0) is set to '0'. 0 = Not acknowledged 1 = Acknowledged.
	AcknowledgeRegister Bit 3: AckInterlockPit	bool	Indicates if an InterlockPit control bit was acknowledged by the device. This bit is only active if AutoAckControlBits (register 00005, bit 0) is set to '0'. 0 = Not acknowledged 1 = Acknowledged.
	AcknowledgeRegister Bit 4: AckAutoPit	bool	Indicates if an AutoPit control bit was acknowledged by the device. This bit is only active if AutoAckControlBits (register 00005, bit 0) is set to '0'. 0 = Not acknowledged 1 = Acknowledged.
	AcknowledgeRegister Bit 5: AckCallBack	bool	Indicates if a CallBack control bit was acknowledged by the device. This bit is only active if AutoAckControlBits (register 00005, bit 0) is set to '0'. 0 = Not acknowledged 1 = Acknowledged.
00202	PitStatus Bit 0: RESERVED	–	–
	PitStatus Bit 1: AlarmActive	bool	Actual alarm condition. 0 = No active alarms 1 = One or more active alarms.
	PitStatus Bit 2: WarningActive	bool	Actual warning condition. 0 = No active warnings 1 = One or more active warnings.
	PitStatus Bit 3: ManualControl	bool	Manual control condition. 0 = Not in manual control mode 1 = Manual control active.
	PitStatus Bit 4: ScadaPinCodeEnabled	bool	PIN code functionality. 0 = No PIN code required 1 = PIN code required to perform remote control and configuration.
	PitStatus Bit 5: WriteAccess	bool	Remote write access. 0 = No write access (PIN code is incorrect) 1 = Full write access (PIN code is either correct or not enabled).
00203	OperatingMode	enum	Register for reading the actual operating mode of the pit. 0 = Standby (stopped by level control) 1 = Start-up delay 2 = Pumping 3 = Stop delay 4 = Pumping max. 5 = Not used 6 = Foam draining 7 = Daily emptying 8 = Pump anti-seizing 9 = Manual control (all enabled pumps in manual control mode) 10 = Interlock control (the pit is interlocked) 11 = Mains supply fault 12 = Level sensor fault 13 = All enabled pumps in alarm 14 = All pumps out of operation.
00204	PitPumpsPresence Bit 0: Pump1Presence	bool	Actual presence of pit pump 1. 0 = Not present 1 = Present.
	PitPumpsPresence Bit 1: Pump2Presence	bool	Actual presence of pit pump 2. 0 = Not present 1 = Present.

Address	Register name	Scale	Description
00205	PitPumpsDisabled Bit 0: Pump1Disabled	bool	Actual enabled/disabled state of pump 1, i.e. the pump in or out of operation. 0 = Enabled 1 = Disabled.
	PitPumpsDisabled Bit 1: Pump2Disabled	bool	Actual enabled/disabled state of pump 2, i.e. the pump in or out of operation. 0 = Enabled 1 = Disabled.
00206	PitPumpsRunning Bit 0: Pump1Running	bool	Actual running state of pump 1. 0 = Not running 1 = Running.
	PitPumpsRunning Bit 1: Pump2Running	bool	Actual running state of pump 2. 0 = Not running 1 = Running.
00207	PitPumpsMonitoringFault Bit 0: Pump1MonitoringFault	bool	Actual fault state of pump 1 monitoring devices, e.g. IO 111. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	PitPumpsMonitoringFault Bit 1: Pump2MonitoringFault	bool	Actual fault state of pump 2 monitoring devices, e.g. IO 111. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
00208	PitPumpsWarning Bit 0: Pump1Warning	bool	Warning state of pump 1. 0 = No warning 1 = Warning.
	PitPumpsWarning Bit 1: Pump2Warning	bool	Warning state of pump 2. 0 = No warning 1 = Warning.
00209	PitPumpsAlarm Bit 0: Pump1Alarm	bool	Alarm state of pump 1. 0 = No alarm 1 = Alarm.
	PitPumpsAlarm Bit 1: Pump2Alarm	bool	Alarm state of pump 2. 0 = No alarm 1 = Alarm.
00210	PitAlarms1	bits	Pit alarm events, item 1. Bit-interpreted. See section 6.13 Alarms and warnings .
00211	PitAlarms2	bits	Pit alarm events, item 2. Bit-interpreted. See section 6.13 Alarms and warnings .
00212	PitAlarms3	bits	Pit alarm events, item 3. Bit-interpreted. See section 6.13 Alarms and warnings .
00213	PitWarnings1	bits	Pit warning events, item 1. Bit-interpreted. See section 6.13 Alarms and warnings .
00214	PitWarnings2	bits	Pit warning events, item 2. Bit-interpreted. See section 6.13 Alarms and warnings .
00215	PitWarnings3	bits	Pit warning events, item 3. Bit-interpreted. See section 6.13 Alarms and warnings .
00216	EventLogLatestID	unscaled	ID code of the latest event log.
00217	NumberOfFloatSwitches	unscaled	Number of installed float switches in the pit (0-5).
00218	FloatSwitchesStatus Bit 0: FloatSwitch1Status	bool	On/off state of float switch 1 (if installed). 0 = Off 1 = On.
	FloatSwitchesStatus Bit 1: FloatSwitch2Status	bool	On/off state of float switch 2 (if installed). 0 = Off 1 = On.
	FloatSwitchesStatus Bit 2: FloatSwitch3Status	bool	On/off state of float switch 3 (if installed). 0 = Off 1 = On.
	FloatSwitchesStatus Bit 3: FloatSwitch4Status	bool	On/off state of float switch 4 (if installed). 0 = Off 1 = On.
	FloatSwitchesStatus Bit 4: FloatSwitch5Status	bool	On/off state of float switch 5 (if installed). 0 = Off 1 = On.

Address	Register name	Scale	Description
00219	FloatSwitch1Function	enum	Function of the float switch. 0 = Not used 1 = Dry running 2 = – 3 = Stop all pumps 4 = Stop 5 = Stop 1 (the first pump) 6 = Stop 2 (the second pump) 11 = Start/stop 12 = Start 1 (the first pump)/stop 13 = Start 14 = Start 1 (the first pump) 15 = Start 2 (the second pump) 20 = Start all pumps 21 = Alarm level 23 = High level.
00220	FloatSwitch2Function	enum	Function of the float switch. 0 = Not used 1 = Dry running 2 = – 3 = Stop all pumps 4 = Stop 5 = Stop 1 (the first pump) 6 = Stop 2 (the second pump) 11 = Start/stop 12 = Start 1 (the first pump)/stop 13 = Start 14 = Start 1 (the first pump) 15 = Start 2 (the second pump) 20 = Start all pumps 21 = Alarm level 23 = High level.
00221	FloatSwitch3Function	enum	Function of the float switch. 0 = Not used 1 = Dry running 2 = – 3 = Stop all pumps 4 = Stop 5 = Stop 1 (the first pump) 6 = Stop 2 (the second pump) 11 = Start/stop 12 = Start 1 (the first pump)/stop 13 = Start 14 = Start 1 (the first pump) 15 = Start 2 (the second pump) 20 = Start all pumps 21 = Alarm level 23 = High level.
00222	FloatSwitch4Function	enum	Function of the float switch. 0 = Not used 1 = Dry running 2 = – 3 = Stop all pumps 4 = Stop 5 = Stop 1 (the first pump) 6 = Stop 2 (the second pump) 11 = Start/stop 12 = Start 1 (the first pump)/stop 13 = Start 14 = Start 1 (the first pump) 15 = Start 2 (the second pump) 20 = Start all pumps 21 = Alarm level 23 = High level.

Address	Register name	Scale	Description
00223	FloatSwitch5Function	enum	Function of the float switch. 0 = Not used 1 = Dry running 2 = – 3 = Stop all pumps 4 = Stop 5 = Stop 1 (the first pump) 6 = Stop 2 (the second pump) 11 = Start/stop 12 = Start 1 (the first pump)/stop 13 = Start 14 = Start 1 (the first pump) 15 = Start 2 (the second pump) 20 = Start all pumps 21 = Alarm level 23 = High level.
00224	PitSensors Bit 0: UltrasonicLevel ControlSensor	bool	Presence of ultrasonic level control sensor. 0 = Not present 1 = Present.
	PitSensors Bit 1: PressureSensor	bool	Presence of pressure sensor. 0 = Not present 1 = Present.
	PitSensors Bit 2: FloatSwitches	bool	Presence of float switches. 0 = Not present 1 = Present.
	PitSensors Bit 3: FlowSensor	bool	Presence of flow sensor. 0 = Not present 1 = Present.
	PitSensors Bit 4: Power/EnergySensor	bool	Presence of power/energy sensor. 0 = Not present 1 = Present.
00225	DayCounterZeroTime	enum	Zero time for today and yesterday counters. Range: 0-23 hours.
00226	InterlockTimeout	1 min.	Actual interlock timeout value in minutes. A new value can be set in the SetInterlockTimeout (register 00111).
00227	RESERVED	–	–
00228	RealTimeClockHI	1 s	The real-time clock in the CU 361 in seconds since midnight January 1st 1970 (UNIX time). See section 6.11 Real-time clock .
00229	RealTimeClockLO		
00230	RtcSecond	1 second	Second of the minute [0; 59]. See section 6.11 Real-time clock .
00231	RtcMinute	1 min.	Minute of the hour [0; 59]. See section 6.11 Real-time clock .
00232	RtcHour	1 hour	Hour of the day [0; 23]. See section 6.11 Real-time clock .
00233	RtcDay	1 day	Day of the month [1; 31]. See section 6.11 Real-time clock .
00234	RtcMonth	1 month	Month of the year [1; 12]. See section 6.11 Real-time clock .
00235	RtcYear	1 year	Year [0; 254] = [year 2000; year 2254]. See section 6.11 Real-time clock .
00236	GSMSignalLevelActual	1 %	Actual value of GSM signal level.
00237	GSMSignalLevelAverage	1 %	Average value of GSM signal level.
00238	IPAddressHI	unscaled	High-order part of IP address (GPRS only).
00239	IPAddressLO	unscaled	Low-order part of IP address (GPRS only).
00240	OverflowLevel	0.01 m	Actual level for activation of overflow level alarm.
00241	HighLevel	0.01 m	Actual level for activation of high-level alarm.
00242	AlarmLevel	0.01 m	Actual level for activation of alarm level alarm.
00243	DryRunningLevel	0.01 m	Actual level for activation of dry-running level alarm.
00244	FoamDrainingLevel	0.01 m	Actual level for foam-draining stop.
00245	StartLevelPump1	0.01 m	Actual start level for the first pump.
00246	StopLevelPump1	0.01 m	Actual stop level for the first pump.
00247	StartLevelPump2	0.01 m	Actual start level for the second pump.
00248	StopLevelPump2	0.01 m	Actual stop level for the second pump.

5.6 Pit data register block

Registers in this block can be read by means of function codes 0x03 and/or 0x04. It is not possible to write to these registers. The table below shows for which controller type the registers are supported.

0xFFFF indicates that the data value is not available.

Address	Register name	Scale	Description
00301	PitWaterLevel	0.01 m	Sensor-measured water level in the pit. Requires a level sensor.
00302	PitSwitchWaterLevel	enum	Float-switch-detected water level in the pit. Requires one or more float switches. Range: 0 to 5.
00303	PitDepth	0.01 m	Depth of the pit.
00304	PitFlowIn	0.1 l/s	Actual flow into the pit. Requires a flow sensor or flow calculation from level sensor.
00305	PitAverageFlowIn	0.1 l/s	Average flow into the pit. Requires a flow sensor or flow calculation from level sensor.
00306	PitFlowOut	0.1 l/s	Actual flow out of the pit. Requires a flow sensor or flow calculation from level sensor.
00307	PitAverageFlowOut	0.1 l/s	Average flow out of the pit. Requires a flow sensor or flow calculation from level sensor.
00308	PitPowerHI	1 W	Power consumption of the pit. Requires a power sensor/MP 204.
00309	PitPowerLO		
00310	PitEnergyHI	0.1 kWh	Energy consumption of the pit. Requires a power sensor/MP 204.
00311	PitEnergyLO		
00312	PitEnergyYesterday	0.1 kWh	Energy consumption of the pit yesterday. Requires a power sensor/MP 204.
00313	PitEnergyToday	0.1 kWh	Energy consumption of the pit today. Requires a power sensor/MP 204.
00314	PitSpecificEnergy	1 Wh/m ³	Specific energy consumption of the pit. Requires a power sensor/MP 204 and a flow sensor.
00315	PitPumpedVolumeHI	0.1 m ³	Total pumped volume. Requires a flow sensor or flow calculation from level sensor.
00316	PitPumpedVolumeLO		
00317	PitPumpedVolumeYesterday	0.1 m ³	Total pumped volume yesterday. Requires a flow sensor or flow calculation from level sensor.
00318	PitPumpedVolumeToday	0.1 m ³	Total pumped volume today. Requires a flow sensor or flow calculation from level sensor.
00319	PitMixerStartsPerHour	unscaled	Number of mixer starts per hour. Requires the presence of a mixer.
00320	PitOverflowVolume	0.1 m ³	Pit overflow volume. Requires a level sensor.
00321	PitOverflowVolumeYesterday	0.1 m ³	Pit overflow volume yesterday. Requires a level sensor.
00322	PitOverflowVolumeToday	0.1 m ³	Pit overflow volume today. Requires a level sensor.
00323	PitOverflowTime	1 min.	Pit overflow time. Requires a level sensor or float switches.
00324	PitOverflowTimeYesterday	1 min.	Pit overflow time yesterday. Requires a level sensor or float switches.
00325	PitOverflowTimeToday	1 min.	Pit overflow time today. Requires a level sensor or float switches.
00326	PitOverflowCounter	unscaled	Number of pit overflows. Requires a level sensor or float switches.
00327	PitOverflowCounterYesterday	unscaled	Number of pit overflows yesterday. Requires a level sensor or float switches.
00328	PitOverflowCounterToday	unscaled	Number of pit overflows today. Requires a level sensor or float switches.
00329	PitOperatingTimeHI	1 min.	Total pit operating time (power-on time).
00330	PitOperatingTimeLO		
00331	Pit2PumpsOprTimeHI	1 min.	Total operating time (two pumps operating simultaneously).
00332	Pit2PumpsOprTimeLO		
00333	Pit2PumpsOprTimeYesterday	1 min.	Operating time yesterday (two pumps operating simultaneously).
00334	Pit2PumpsOprTimeToday	1 min.	Operating time today (two pumps operating simultaneously).
00335 - 00350	RESERVED	—	—
00351	UserAnalogInput1	0.1 %	User-defined measurement on analog input 1.
00352	UserAnalogInput2	0.1 %	User-defined measurement on analog input 2.
00353	UserAnalogInput3	0.1 %	User-defined measurement on analog input 3.

5.7 Pump 1 – data and status module register block

All register values are read-only, and 0xFFFF indicates that the data value is not available.

Address	Register name	Scale	Description
00401	Pump1Status Bit 0: Presence	bool	Actual presence of pump. 0 = Not present 1 = Present.
	Pump1Status Bit 1: Running	bool	Actual running state of pump. 0 = Not running 1 = Running.
	Pump1Status Bit 2: MonitoringFault	bool	Actual fault state of pump monitoring devices. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	Pump1Status Bit 3: Warning	bool	Warning state of pump. 0 = No warning 1 = Warning.
	Pump1Status Bit 4: Alarm	bool	Alarm state of pump. 0 = No alarm 1 = Alarm.
	Pump1Status Bit 5: IO111Present	bool	Presence of auxiliary equipment IO 111. 0 = Not present 1 = Present.
	Pump1Status Bit 6: IO111Fault	bool	Fault state of auxiliary equipment IO 111. 0 = No fault 1 = Fault.
	Pump1Status Bit 7: MP204Present	bool	Presence of auxiliary equipment MP 204. 0 = Not present 1 = Present.
	Pump1Status Bit 8: MP204Fault	bool	Fault state of auxiliary equipment MP 204. 0 = No fault 1 = Fault.
	Pump1Status Bit 9: SM111Present	bool	Presence of auxiliary equipment SM 111. 0 = Not present 1 = Present.
	Pump1Status Bit 10: SM111Fault	bool	Fault state of auxiliary equipment SM 111. 0 = No fault 1 = Fault.
00402	Pump1Status Bit 11: PumpDisabled	bool	Actual enabled/disabled state of the pump. 0 = Enabled 1 = Disabled (e.g. for temporary maintenance).
	Pump1ControlSource	enum	Actual control source of the pump. 0 = Auto 1 = Switch 2 = Display 3 = Remote-controlled by bus.
00403	Pump1ConnectionType	enum	Pump connection type. 0 = The pump is controlled via a CU 361 output relay. 1 = The pump is controlled via an IO 351 output relay. 2 = The pump is controlled via MP 204 actuator function. 3 = The pump is controlled via its bus interface.
00404	Pump1OperatingTimeHI	1 min.	Total operating (running) time.
00405	Pump1OperatingTimeLO		
00406	Pump1TimeToServiceHI	1 min.	Time to next service.
00407	Pump1TimeToServiceLO		
00408	Pump1OperatingTimeYesterday	1 min.	Operating (running) time yesterday.
00409	Pump1OperatingTimeToday	1 min.	Operating (running) time today.
00410	Pump1LatestOperatingTime	1 s	Operating (running) time last time it was operated.
00411	Pump1StartCounterHI	unscaled	Total number of pump starts.
00412	Pump1StartCounterLO		
00413	Pump1StartCounterYesterday	unscaled	Total number of pump starts yesterday.
00414	Pump1StartCounterToday	unscaled	Total number of pump starts today.
00415	Pump1StartsPerHour	unscaled	Number of pump starts within the last hour.
00416	Pump1Flow	0.1 l/s	Calculated average or measured pump flow.
00417	Pump1LatestFlow	0.1 l/s	Latest calculated/measured flow (capacity).
00418	Pump1Current	0.1 A	Motor current.
00419	Pump1LatestCurrent	0.1 A	Latest motor current.
00420	RESERVED	–	–

Address	Register name	Scale	Description
00421	Pump1Insulation	10 k Ω	Motor insulation resistance.
00422	Pump1WaterInOil	0.1 %	Motor water-in-oil measurement.
00423	Pump1Alarms1	bits	Pump alarms, item 1. Bit-interpreted. See section 6.13 Alarms and warnings .
00424	Pump1Alarms2	bits	Pump alarms, item 2. Bit-interpreted. See section 6.13 Alarms and warnings .
00425	Pump1Alarms3	bits	Pump alarms, item 3. Bit-interpreted. See section 6.13 Alarms and warnings .
00426	Pump1Warnings1	bits	Pump warnings, item 1. Bit-interpreted. See section 6.13 Alarms and warnings .
00427	Pump1Warnings2	bits	Pump warnings, item 2. Bit-interpreted. See section 6.13 Alarms and warnings .
00428	Pump1Warnings3	bits	Pump warnings, item 3. Bit-interpreted. See section 6.13 Alarms and warnings .
00429	Pump1MotorTemperature1	1 °C	Motor temperature 1.

5.8 Pump 2 – data and status module register block

All register values are read-only and 0xFFFF indicates that the data value is not available.

Address	Register name	Scale	Description
00451	Pump2Status Bit 0: Presence	bool	Actual presence of pump. 0 = Not present 1 = Present.
	Pump2Status Bit 1: Running	bool	Actual running state of pump. 0 = Not running 1 = Running.
	Pump2Status Bit 2: MonitoringFault	bool	Actual fault state of pump monitoring devices. 0 = No fault 1 = Fault in auxiliary equipment or sensors.
	Pump2Status Bit 3: Warning	bool	Warning state of pump. 0 = No warning 1 = Warning.
	Pump2Status Bit 4: Alarm	bool	Alarm state of pump. 0 = No alarm 1 = Alarm.
	Pump2Status Bit 5: IO111Present	bool	Presence of auxiliary equipment IO 111. 0 = Not present 1 = Present.
	Pump2Status Bit 6: IO111Fault	bool	Fault state of auxiliary equipment IO 111. 0 = No fault 1 = Fault.
	Pump2Status Bit 7: MP204Present	bool	Presence of auxiliary equipment MP 204. 0 = Not present 1 = Present.
	Pump2Status Bit 8: MP204Fault	bool	Fault state of auxiliary equipment MP 204. 0 = No fault 1 = Fault.
	Pump2Status Bit 9: SM111Present	bool	Presence of auxiliary equipment SM 111. 0 = Not present 1 = Present.
	Pump2Status Bit 10: SM111Fault	bool	Fault state of auxiliary equipment SM 111. 0 = No fault 1 = Fault.
	Pump2Status Bit 11: PumpDisabled	bool	Actual enabled/disabled state of the pump. 0 = Enabled 1 = Disabled (e.g. for temporary maintenance).
00452	Pump2ControlSource	enum	Actual control source of the pump. 0 = Auto 1 = Switch 2 = Display 3 = Remote-controlled by bus.
00453	Pump2ConnectionType	enum	Pump connection type. 0 = The pump is controlled via a CU 361 output relay. 1 = The pump is controlled via an IO 351 output relay. 2 = The pump is controlled via MP 204 actuator function. 3 = The pump is controlled via its bus interface.
00454	Pump2OperatingTimeHI	1 min.	Total operating (running) time.
00455	Pump2OperatingTimeLO		
00456	Pump2TimeToServiceHI	1 min.	Time to next service.
00457	Pump2TimeToServiceLO		
00458	Pump2OperatingTimeYesterday	1 min.	Operating (running) time yesterday.
00459	Pump2OperatingTimeToday	1 min.	Operating (running) time today.
00460	Pump2LatestOperatingTime	1 s	Operating (running) time last time it was operated.
00461	Pump2StartCounterHI	unscaled	Total number of pump starts.
00462	Pump2StartCounterLO		
00463	Pump2StartCounterYesterday	unscaled	Total number of pump starts yesterday.
00464	Pump2StartCounterToday	unscaled	Total number of pump starts today.
00465	Pump2StartsPerHour	unscaled	Number of pump starts within the last hour.
00466	Pump2Flow	0.1 l/s	Calculated average or measured pump flow.
00467	Pump2Latest Flow	0.1 l/s	Latest calculated/measured flow (capacity).
00468	Pump2Current	0.1 A	Motor current.
00469	Pump2LatestCurrent	0.1 A	Latest motor current.
00470	RESERVED	–	–

Address	Register name	Scale	Description
00471	Pump2Insulation	10 kΩ	Motor insulation resistance.
00472	Pump2WaterInOil	0.1 %	Motor water-in-oil measurement.
00473	Pump2Alarms1	bits	Pump alarms, item 1. Bit-interpreted. See section 6.13 <i>Alarms and warnings</i> .
00474	Pump2Alarms2	bits	Pump alarms, item 2. Bit-interpreted. See section 6.13 <i>Alarms and warnings</i> .
00475	Pump2Alarms3	bits	Pump alarms, item 3. Bit-interpreted. See section 6.13 <i>Alarms and warnings</i> .
00476	Pump2Warnings1	bits	Pump warnings, item 1. Bit-interpreted. See section 6.13 <i>Alarms and warnings</i> .
00477	Pump2Warnings2	bits	Pump warnings, item 2. Bit-interpreted. See section 6.13 <i>Alarms and warnings</i> .
00478	Pump2Warnings3	bits	Pump warnings, item 3. Bit-interpreted. See section 6.13 <i>Alarms and warnings</i> .
00479	Pump2MotorTemperature1	1 °C	Motor temperature 1.

5.9 Simulation register block

Address	Register name	Scale	Description
00701	SimulationEventCode	enum	Event code to simulate.
00702	SimulationEventSource	enum	Event source to simulate.
00703	SimulationEventDeviceNo	enum	Event device number to simulate.
00704	SimulationEventActionType	enum	0 = Warning 1 = Alarm 2 = Disabled.
00705	SimulationActivate	bool	Activation of simulation features. 0 = Deactivate simulation 1 = Activate simulation.
00706	SimulationStatus Bit 0: SimulationActive	bool	State of simulation. 0 = Not active 1 = Active.

5.10 User register block

Address	Register name	Scale	Description
00751- 00800	UserRegisters	unscaled	This area is for device labelling by the user. Neither the CU 361 nor the CIM 250 will modify this area. The user area values are stored in the device, and will remain after a power-off.

5.11 Name string register block

Address	Register name	Scale	Description
00801- 00920	NameRegisterArea	UTF-8 chars.	Name string read from the CU 361. UTF-8 is a variable-length character encoding for Unicode. It can represent any character in the Unicode standard. It may take up to 60 seconds for a change to be visible.

5.12 Hour log register block

Generally the Modbus master application can select the relevant log series and the relevant number of hours back in time. Typically several communication sessions (request telegrams) are needed to read the data.

The CIM 250 ensures that logged data is protected against internal update during the time it is accessed from Modbus, so that the Hour log constitutes a time-consistent block (data coherency). Every time the real-time clock increments by one hour, all the logged data in the Hour log is shifted one hour back in time (and the oldest data set is cleared). The exact time where this happens will be delayed a few seconds relative to the hour incrementation, so to be sure to read Hour log data that has been correctly updated, it is recommended to read data at least 30 seconds after the hour incrementation.

Address	Register name	Scale	Description
02001-02072	PitOverflowTimeHourLog1...72	1 min.	Pit, incremental overflow time, hour log 1...72.
02073-02144	PitOverflowCntHourLog1...72	unscaled	Pit, incremental number of overflows, hour log 1...72.
02145-02216	PitOverflowVolumeHourLog1...72	0.1 m ³	Pit, incremental overflow volume, hour log 1...72.
02217-02288	PitSpecificEnergyHourLog1...72	1 Wh/m ³	Pit, specific energy, hour log 1...72.
02289-02360	PitVolumeHourLog1...72	0.1 m ³	Pit, incremental pumped volume, hour log 1...72.
02361-02432	PitEnergyHourLog1...72	0.1 kWh	Pit, incremental energy consumption, hour log 1...72.
02433-02504	Pit2PumpsOprTimeHourLog1...72	1 min.	Pit, incremental operating time (two pumps operating simultaneously), hour log 1...72.
02505-02792	Reserved addresses	–	–
02793-02864	Pump1OprTimeHourLog1...72	1 min.	Pump 1, incremental operating time, hour log 1...72.
02865-02936	Pump1StartCntHourLog1...72	unscaled	Pump 1, incremental number of starts, hour log 1...72.
02937-03008	Pump1AvgFlowHourLog1...72	0.1 l/s	Pump 1, average flow, hour log 1...72.
03009-03080	Pump1AvgCurrentHourLog1...72	0.1 A	Pump 1, average current, hour log 1...72.
03081-03152	Pump2OprTimeHourLog1...72	1 min.	Pump 2, incremental operating time, hour log 1...72.
03153-03224	Pump2StartCntHourLog1...72	unscaled	Pump 2, incremental number of starts, hour log 1...72.
03225-03296	Pump2AvgFlowHourLog1...72	0.1 l/s	Pump 2, average flow, hour log 1...72.
03297-03368	Pump2AvgCurrentHourLog1...72	0.1 A	Pump 2, average current, hour log 1...72.

5.13 Event log register block

The event log contains the latest 50 event entries. Each entry consists of seven registers, containing information about the event.

Address	Register name	Scale	Description
06001	NoOfEventsInLog	unscaled	Number of events in the event log.
06002	EventIDLog1	unscaled	Event ID for logged event No. 1.
06003	EventCodeLog1	enum	Event code for logged event No. 1.
06004	EventSourceLog1	enum	Event source for logged event No. 1. 0 = System 1 = CU 361 2 = IO 351 3 = IO 111, pump 4 = MP 204, pump 5 = Analog input 6 = Pump 7 = Add-on CIM 8 = Battery/UPS 9 = Mixer 10 = Analog input, level sensor 11 = Analog input, flow sensor 12 = Analog input, power sensor 13 = Analog input, user-defined sensor.
06005	EventDeviceNo	unscaled	Device number related to the event or its recognition. 0 = No related number 1 = Value of related number, e.g. pit (wastewater) pump 1 2 = Value of related number, e.g. pit (wastewater) pump 2 3 = Value of related number, e.g. user-defined sensor 3.
06006	EventTypeAndConditionLog1	enum	Event type and condition of logged event No. 1. 0 = – 1 = Alarm condition appears 2 = Alarm condition disappears 3 = Warning condition appears 4 = Warning condition disappears.
06007	EventTimeStampLog1HI	1 s	Seconds since midnight January 1st 1970 (UNIX time).
06008	EventTimeStampLog1LO		
06009-06344	Event log 2...49	–	–
06345	EventIDLog50	unscaled	Event ID for logged event No. 50.
06346	EventCodeLog50	enum	Event code for logged event No. 50.
06347	EventSourceLog50	enum	Event source for logged event No. 50.
06348	EventDeviceNo	unscaled	Device number related to the event or its recognition.
06349	EventTypeAndConditionLog50	enum	Event type and condition of logged event No. 50.
06350	EventTimeStampLog50HI	1 s	Seconds since midnight January 1st 1970 (UNIX time).
06351	EventTimeStampLog50LO		

5.14 Data log index

This is an index area for the configurable data log. The log data index registers are read-only.

See section [6.3 Reading the configurable data log series](#) for detailed information on how to read the configurable log series.

By default the configurable logs are not set up. This can only be done with the Grundfos PC Tool WW Controls or via the CU 361 control panel. For further information, see installation and operating instructions for Dedicated Controls.

Address	Register name	Scale	Description
07001	NoOfLogSeries	unscaled	Number of available log series L [0; 64].
07002	LogSeries1ItemNo	unscaled	Log series 1 item number. See section 6.3 Reading the configurable data log series .
07003	LogSeries1RegAddr	unscaled	Register start address of log series 1.
07004	LogSeries1SamplingTime	1 s	Time period between samples in log series 1.
07005	LogSeries1NoOfSamples	unscaled	Number of samples in log series 1, N_1 .
07006	LogSeries2ItemNo	unscaled	Log series 2 item number. See section 6.3 Reading the configurable data log series .
07007	LogSeries2RegAddr	unscaled	Register start address of log series 2.
07008	LogSeries2SamplingTime	1 s	Time period between samples in log series 2.
07009	LogSeries2NoOfSamples	unscaled	Number of samples in log series 2, N_2 .
...	LogSeries#ItemNo	unscaled	Log series # item number. See section 6.3 Reading the configurable data log series .
...	LogSeries#RegAddr	unscaled	Register start address of log series #.
...	LogSeries#SamplingTime	1 s	Time period between samples in log series #.
...	LogSeries#NoOfSamples	unscaled	Number of samples in log series #, $N_{\#}$.
...	LogSeriesLItemNo	unscaled	Log series L item number (last series). See section 6.3 Reading the configurable data log series .
...	LogSeriesLRegAddr	unscaled	Register start address of log series L.
...	LogSeriesLSamplingTime	1 s	Time period between samples in log series L.
...	LogSeriesLNoOfSamples	unscaled	Number of samples in log series L, N_L .
...	LogSeriesEndMark	unscaled	End mark to end the index. Is always 0.

... indicates variable register address.

5.15 Data log series

Data area for the configurable data log series (max. 64 series). The log data are read-only and have a fixed starting address, so log series 1 always starts at register 07301.

See section [6.3 Reading the configurable data log series](#) for detailed information on how to read the configurable log series.

Address	Register name	Scale	Description
07301	LogSeries1ItemNo	unscaled	Log series 1 item number. See section 6.3 Reading the configurable data log series .
07302	LogSeries1SamplingTime	1 s	Time period between samples in log series 1, configurable on the CU 361 control panel.
07303	LogSeries1NoOfSamples	unscaled	Number of samples in log series 1, N_1 , configurable on the CU 361 control panel.
07304	LogSeries1TimeStampHI	1 s	Log series 1 Unix time stamp. Subtracting "Sampling time" gives the time stamp of sample No. 2 in this series, etc.
07305	LogSeries1TimeStampLO	1 s	–
07306	LogSeries1Sample1	–	Value of log series 1 sample No. 1.
...	LogSeries1SampleN1	–	Value of log series 1 sample No. N_1 (last sample in series).
...	LogSeries2ItemNo	–	Log series 2 item number. See section 6.3 Reading the configurable data log series .
...	LogSeries2SamplingTime	–	Time period between samples in log series 2, configurable on the CU 361 control panel.
...	LogSeries2TimeStampHI	–	Log series 2 Unix time stamp. Subtracting "Sampling time" gives the time stamp of sample No. 2 in this series, etc.
...	LogSeries2TimeStampLO	–	–
...	LogSeries2Sample1	–	Value of log series 2 sample No. 1.
...	...	–	–
...	LogSeries2SampleN2	–	Value of log series 2 sample No. N_2 (last sample in series).
...	LogSeries#ItemNo	–	Log series # item number. See section 6.3 Reading the configurable data log series .
...	LogSeries#SamplingTime	–	Time period between samples in log series #.
...	LogSeries#NoOfSamples	–	Number of samples in log series #, $N_{\#}$.
...	LogSeries#TimeStampHI	–	Log series # Unix time stamp. Subtracting "Sampling time" gives the time stamp of sample No. 2 in this series, etc.
...	LogSeries#TimeStampLO	–	–
...	LogSeries#Sample1	–	Value of log series # sample No. 1.
...	...	–	–
...	LogSeries#SampleN#	–	Value of log series # sample No. $N_{\#}$ (last sample in series).
...	LogSeriesLItemNo	–	Log series L item number. See section 6.3 Reading the configurable data log series .
...	LogSeriesLSamplingTime	–	Time period between samples in log series L.
...	LogSeriesLNoOfSamples	–	Number of samples in log series L, N_L .
...	LogSeriesLTimeStampHI	–	Log series L Unix time stamp. Subtracting "Sampling time" gives the time stamp of sample No. 2 in this series, etc.
...	LogSeriesLTimeStampLO	–	–
...	LogSeriesLSample1	–	Value of log series L sample No. 1.
...	...	–	–
...	LogSeriesLSampleN1	–	Value of log series L sample No. N_L (last sample in series).

... indicates variable register address.

6. Detailed descriptions

6.1 SCADA PIN code protection

It is always possible to get read access via Modbus, but if the CU 361 is SCADA PIN-code-protected (PitStatus.ScadaPinCodeEnabled, register 00202, bit 4 = 1), write access requires that the correct PIN code (ScadaPinCode, register 00109) has been written.

Writing the correct PIN code value will trigger the write access control, and write access will be open, which can be verified with the status bit PitStatus.WriteAccess (register 00202, bit 5 = 1).

To remove write access via Modbus, the SCADA PIN code input register (ScadaPinCode, register 00109) must be set with a value of 0.

The SCADA PIN code protection is enabled or disabled via the CU 361 control panel and cannot be enabled or disabled via Modbus. See installation and operating instructions for Dedicated Controls.

To find the parameter in the CU 361, go to

Settings > Communication settings > SCADA settings.

6.2 Reading the event log

The event log has a size of 350 registers containing the latest 50 alarm and warning events. The number of contained event logs can be read from NoOfEventsInLog (register 06001).

Each event is represented as an event record of seven registers:

- EventID
- EventCode
- EventSource
- EventDeviceNo
- EventTypeAndCondition
- EventTimeStampHI
- EventTimeStampLO.

The EventID is a unique "tag" for the event record. These IDs are incremented successively corresponding to the succession of the events they represent. The event log can be handled in three ways:

- Reading the complete log (all 50 event records) regularly and afterwards sorting "new" ones from "old" ones.
- Reading the event ID of the latest record EventLogLatestID (register 00216) and comparing with the event ID of the latest record that has been read previously to see how many "new" records there have been generated. Then afterwards reading only the "new" ones.
- Clearing the event log with PitControl.ResetEventLog (register 00101, bit 2) after it has been read. Then the event log will always contain "new" events only.

The CIM 250 ensures that logged data is protected against internal update during the time it is accessed from Modbus, so that the event log constitutes a time-consistent block (data coherency).

Note

6.3 Reading the configurable data log series

LogSeriesItemNo

The log series item numbers are shown in the table below.

Note that the scaling of the registers with the present values is identical to the scaling of the logged data values except for power values where the scaling has been changed from [1 W] to [10 W] to fit into 16 bit.

Log series item No.	Log item register	Scale
0001	PitWaterLevel	0.01 m
0002	PitSwitchWaterLevel	unscaled
0003	PitFlowIn	0.1 l/s
0004	PitAverageFlowIn	0.1 l/s
0005	PitFlowOut	0.1 l/s
0006	PitAverageFlowOut	0.1 l/s
0007	PitPower	10 W*
0008	PitSpecificEnergy	1 Wh/m ³
0010	PitMixerStartPerH	Unscaled
0500	UserAnalogIn1	0.1 %
0501	UserAnalogIn2	0.1 %
0502	UserAnalogIn3	0.1 %
1000	Pump1Flow	0.1 l/s
1001	Pump1LatestFlow	0.1 l/s
1002	Pump1Current	0.1 A
1003	Pump1Insulation	10 kΩ
1004	Pump1WaterInOil	0.1 %
1005	Pump1MotorTemperature1	1 °C
1006	Pump1MotorTemperature2	1 °C
1007	Pump1CosPhi	0.01
1008	Pump1Power	10 W*
1009	Pump1Voltage	0.1 V
1010	Pump1LatestCurrent	0.1 A
1011	Pump1StartsPerH	Unscaled
1012	Pump1LatestOperatingTime	1 s
2000	Pump2Flow	0.1 l/s
2001	Pump2LatestFlow	0.1 l/s
2002	Pump2Current	0.1 A
2003	Pump2Insulation	10 kΩ
2004	Pump2WaterInOil	0.1 %
2005	Pump2MotorTemperature1	1 °C
2006	Pump2MotorTemperature2	1 °C
2007	Pump2CosPhi	0.01
2008	Pump2Power	10 W*
2009	Pump2Voltage	0.1 V
2010	Pump2LatestCurrent	0.1 A
2011	Pump2StartsPerH	Unscaled
2012	Pump2LatestOperatingTime	1 s

* The data item PitPowerHI/LO (registers 00308 and 00309) has a resolution of 1 W, but the logging is in 10 W.

Log series max. limits	
Total number of samples	40000 registers
Log series max. length	8192 registers (max. value for LogSeriesNoOfSamples)
Max. number of log series	64 (max. value for NoOfLogSeries (register 07001))

6.4 Separation of reads and writes

The functional profile supports Modbus holding registers, which means that registers can be both read and written. By default, most of the register values meant for writing by the Modbus master will also be updated by the CU 361 itself, to reflect the actual value used by the CU 361.

Differences arise due to internal value limitations and because some settings and control values can have other sources (e.g. service port and display) that can change the actual values.

Reading a writing register only means reading what has previously been written to the Modbus interface, and in the general case this will not reflect what value the CU 361 is actually using.

To avoid such conflicts, the profile has the option of read/write separation with the option `Config.ReadWriteSeparation` (register 00006, bit 1 = 1). Using this option means that all writing registers [W] use an associated reading location [R] where the resulting status of the writing always can be verified. In this case, reading and writing never take place via the same registers (Pit Event Simulation registers being the only exceptions).

Example 1

Setting and reading overflow level with `ReadWriteSeparation` disabled (default).

The user writes a new value to `SetOverflowLevel` (register 00121).

The resulting overflow level is then read from `SetOverflowLevel` (register 00121).

Note *`ReadWriteSeparation` is disabled by default.*

Example 2

Setting and reading overflow level with `ReadWriteSeparation` enabled.

The user writes a new value to `SetOverflowLevel` (register 00121).

The resulting overflow level is then read from `OverflowLevel` (register 00240), hence separating reads from writes.

6.5 Control bit acknowledgement

All control bits in the functional profile are triggered on the rising edge of a bit. The system supports two different approaches to control bit acknowledgement: Auto and manual.

The `AutoAckControlBits` setting (register 00005) sets the desired approach:

0 = Disabled.

Control bits are not automatically lowered when accepted by the device. The user must lower the control bit manually before the control bit can be triggered again. When setting a control bit is accepted by the device, the corresponding control bit acknowledgement will be raised, and the user can lower the control bit.

1 = Enabled.

Control bits are automatically lowered when accepted by the device, so the user does not have to lower it manually (default).

Example 1

ResetAlarm with auto-acknowledgement enabled (default).

The user sets the `PitControl.ResetAlarm` control bit (register 00101, bit 0) to 1 to reset an alarm. When accepted by the slave, the `PitControl.ResetAlarm` control bit is automatically reset to 0. The user can then set the `PitControl.ResetAlarm` control bit to 1 again to reset an alarm again.

Note *`AutoAckEnabled` is the default setting.*

Example 2

ResetAlarm with auto-acknowledgement disabled.

The user sets the `PitControl.ResetAlarm` control bit (register 00101, bit 0) to 1 to reset an alarm. When accepted by the slave, the `AcknowledgeRegister.AckResetAlarm` (register 00201, bit 0) is set to 1, and the `PitControl.ResetAlarm` is still 1. The user must then manually set `PitControl.ResetAlarm` to 0 before another alarm can be reset. When doing so, the `AcknowledgeRegister.AckResetAlarm` will revert to 0 as well.

6.6 GSM call-up connection

The call-up function in the Dedicated Controls wastewater system is used for SCADA system communication via the GSM network. Connection is established when the SCADA system dials the CIM 250. The CIM 250 will automatically "pick up the phone call" and wait for data traffic in the form of Modbus RTU telegrams.

If legal data traffic has not been initiated within one minute, the CIM 250 will hang up the line. This silence timeout is active during the whole communication session. Whenever the SCADA system has completed the Modbus communication, it hangs up the line. This is detected by the CIM 250, which also hangs up the line, and the call-up communication session is thereby completed. See fig. 7.

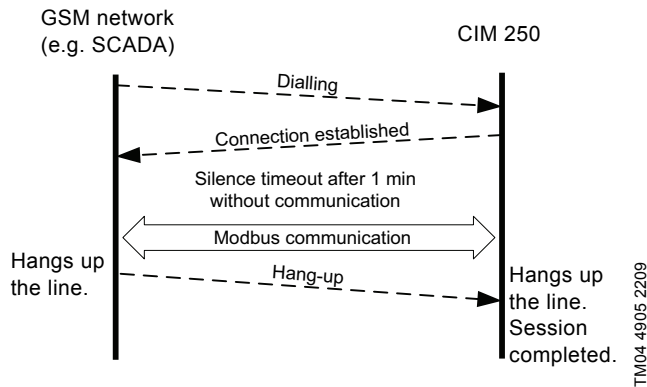


Fig. 7 Illustration of a GSM call-up session

If SCADA PIN code protection is enabled, the ScadaPinCode (register 00109) has to be written with the correct value before write access will be opened. It will then remain open until the call-up session is completed. The next call-up session also has to write the ScadaPinCode to be able to write registers. See installation and operating instructions for Dedicated Controls. Relevant settings in the CU 361:

To find the parameter in the CU 361, go to

Settings > Communication settings > SCADA settings >

- SCADA PIN code enabled
- SCADA PIN code.

6.7 GSM call-back connection

If an alarm appears in the Dedicated Controls wastewater system and the SCADA call-back function in the CU 361 has been enabled in general and also enabled for this particular alarm, the CIM 250 will attempt to establish a phone connection to the SCADA system. Dialling timeout is one minute, and if connection is not established, the CIM 250 hangs up and enters a call-back wait state. Call-back will be retried after one minute. This goes on forever as long as the alarm condition persists. See fig. 8.

If connection is established, the CIM 250 will wait up to one minute for data traffic. If no communication is initiated from the SCADA system, the CIM 250 will hang up, enter a call-back wait state and retry after one minute. See fig. 8.

The SCADA system is expected to start Modbus communication when called. When the appropriate data has been requested or written, the SCADA system has to send a call-back acknowledgement to the CIM 250 to signal that it has received the information needed (Modbus writes to PitControl.CallBackAck, register 00101, bit 5). This is to prevent several call-backs based on the same event.

If SCADA PIN code protection is enabled, the ScadaPinCode (register 00109) has to be written with the correct value before write access will be opened. It will then remain open until the call-back session is completed.

To finally end the sequence, the SCADA system hangs up the line. This is detected by the CIM 250, which also hangs up the line, and the call-back communication session is thereby completed.

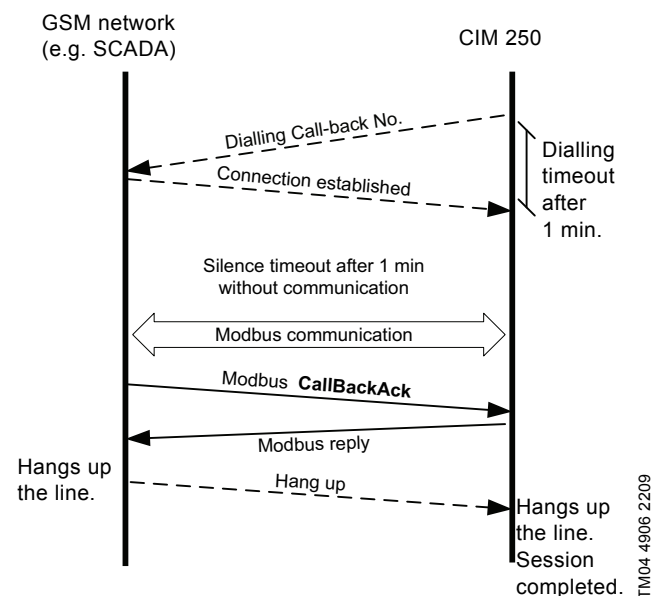


Fig. 8 Principle illustration of a call-back session

To find the parameter in the CU 361, go to

Settings > Communication settings > SCADA settings >

- SCADA call-back enabled
- SCADA call-back phone number
- SCADA PIN code enabled
- SCADA PIN code.

Settings > Alarm settings >

- SCADA call-back enabled for particular alarms.

6.8 Use of SMS messages

The setting up and the use of the SMS functions are described in the installation and operating instructions for Dedicated Controls.

To find the parameter in the CU 361, go to

Settings > Communication settings >

- SMS numbers
- SMS schedule
- SMS heartbeat message
- SMS authentication.

Apart from the SMS functionality described in the previous sections which is related to the Dedicated Controls wastewater system, the CIM 250 will send SMS messages in case of faults or other special conditions of the CIM 250 itself.

Such messages are not dependent on the CU 361. They cannot be disabled, but are generated by the CIM 250 and sent to all numbers in the phone book.

Note

No SMS message will be sent if the phone book is empty (for instance, if the CIM 250 has not been initialised).

The message is triggered by an event. If the CIM 250 is switched off and on (the battery must also be removed), it will send the message again if the cause of the message still exists.

6.8.1 No connection to product

If the communication between the CIM 250 and the CU 361 is interrupted for more than one minute, the CIM 250 will send this message to all numbers in the phone book.

[Installation name]

GSM Module Error:

No connection to product

Note

***If the cause of the interruption is the fact that the power supply to the product was interrupted, the CIM 250 will send this message instead:
No mains supply, using battery. See below.***

6.8.2 No mains supply, using battery

If the CIM 250 detects that it is being supplied from the optional CIM 250 battery, it will send this message to all numbers in the phone book:

[Installation name]

GSM Module Error:

No mains supply, using battery

This fault may disappear by itself, as the message is typically triggered by a short power cut. In case of this special fault (but not the other ones), the CIM 250 will send a message, telling that the fault has disappeared:

[Installation name]

GSM Module:

Mains supply returned

If the battery is worn out or the CIM 250 has no battery, the CIM 250 will not detect that the power supply to the CU 361 has been interrupted, as it will loose power supply itself. Therefore, it cannot send a message. To inform the user that there has been a power cut, the CIM 250 will always send an SMS message when the power supply has returned:

[Installation name]

GSM Module:

Power on occurred

6.8.3 Change GSM module battery

If the CIM 250 detects that the optional CIM 250 battery is worn out and must be replaced, it will send this message to all numbers in the phone book:

[Installation name]

GSM Module Error:

Change GSM Module battery

6.8.4 GSM module battery low

If the CIM 250 detects that the optional CIM 250 battery level is low, it will send this message to all numbers in the phone book:

[Installation name]

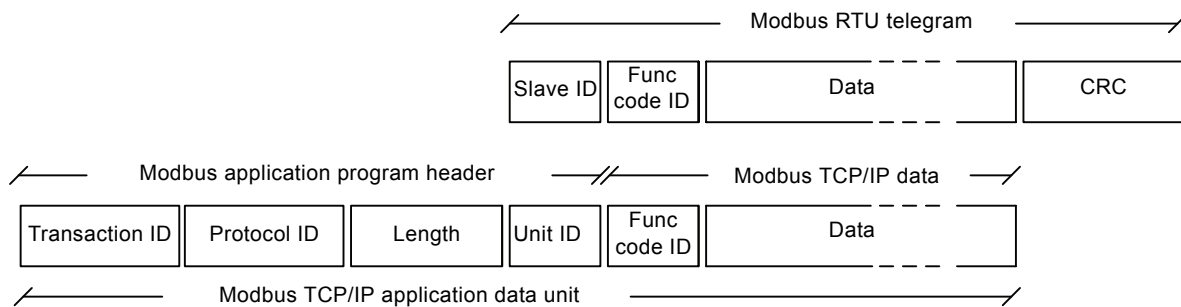
GSM Module Error:

GSM Module battery low

6.9 GPRS connection

GPRS (General Packet Radio Service) is a wireless, "always on" connection that remains active as long as the CIM 250 is within range of the service. With GPRS it is possible to establish a wireless connection to the internet and thus enable a remote connection to a SCADA system computer or another PC application. Typical data rates are 32-48 kbit/s.

The GPRS itself takes care of the wireless data transfer via the GSM network. It plays the same role as Ethernet in a wired network. On top of GPRS is the TCP/IP protocol, which enables easy integration with the internet. The Modbus TCP protocol is used on the application layer communicating with a TCP port number (default 502). The difference when compared to the fieldbus protocol Modbus RTU is the exclusion of the 16-bit CRC checksum and the adding of a Modbus application program header as illustrated below.



TM04 4907 2209

Fig. 9 Modbus TCP telegram

6.9.1 Subscription

The GSM service providers have different technical solutions for GPRS to choose from. You have to select the service provider and the technical solution that best suit your needs, and it must be based on static IP addressing. You will get the following from the GSM service provider:

- A Subscriber Identity Module (SIM card).
- An Access Point Name (APN) (e.g. "internet").
- Username (is fixed and cannot be changed by the user).
- Password (is fixed and cannot be changed by the user).
- A static IP address.

Solutions based on a VPN (Virtual Private Network) involve the use of special routers, e.g. GRE routers, Generic Routing Encapsulation, which you will also get from the service provider.

6.9.2 Installation

Specific settings for GPRS communication in the CU 361:

To find the parameter in the CU 361, go to

Settings > Communication settings > GPRS settings >

- APN
- Username
- Password.

There are some advanced GPRS settings which have default values that usually work, but in special cases, it might be necessary to change some of them. This can only be done with the Grundfos PC Tool WW Controls:

- Authentication: "Normal"/"Secure" (only used by some service providers) (default is "Normal").
- Roaming: "Enabled"/"Disabled" (default is "Disabled").
- Modbus TCP port number (default 502).
- GENIpro port number (default 49152).

Other relevant settings in the CU 361:

To find the parameter in the CU 361, go to

Settings > Communication settings > SCADA settings >

- SCADA PIN code enabled
- SCADA PIN code.

6.9.3 Status

In the CU 361 display "Status > System > GSM/GPRS", you will see the following information:

- GPRS connection state
 - "Detached": No connection to any GPRS service.
 - "Attached": Connection to GPRS service established.
 - "Context active": IP address has been assigned, ready for a client to establish a socket connection.
 - "Connected": A client has established a socket connection. The system is ready for TCP/IP data exchange (or already exchanging data).
- Total GPRS data sent (in kb).
- Total GPRS data received (in kb).
- IP address (e.g. 218.214.34.201).

The same display also supplies statistical information about SMS messages, call-up connections and GSM signal strength.

6.9.4 Operation

When powering on a CU 361 with the correct GSM/GPRS setting, the following GPRS connection sequence will take place:

1. The CIM 250 locates the GSM/GPRS service. The connection state changes from "Detached" to "Attached".
2. The CIM 250 attempts to connect to the APN it has been given and requests an IP address. The base station looks through its record of legal SIM cards and finds the IP address (the address associated with this SIM card) to assign to the CIM 250. After the CIM 250 has got the IP address, the connection state changes to "Context active".
3. The CIM 250 is now ready for a client (e.g. SCADA system) to establish a socket connection and begin TCP/IP data exchange. When a client connects the CU 361, the connection state will change to "Connected", and the GSM status LED1 will indicate when data transfer takes place. See section 3.2 LEDs.

Note

When no GPRS data is being transferred, the connection states "Attached", "Context active" and "Connected". All show the same LED1 status (short pulse).

A client (e.g. SCADA) establishes connection to a CU 361 by specifying the IP address and the TCP port 502. Data transfer is always initiated from the client in the form of a Modbus TCP telegram embedded in a TCP/IP frame and directed to TCP port 502. To the client software, the connection to the CU 361 is completely transparent.

The protection against unauthorised data access is high. The access to the GSM network from the internet can only take place via the VPN tunnel. See fig. 10. Moreover, data transfer requires a Modbus master client, knowledge of the Modbus functional profile and the use of a SCADA PIN code (if enabled).

The CIM 250 supervises the GPRS/GSM system to ensure that it is still working. An automatic procedure ensures restarting of the CIM 250 and repetition of the GPRS connection sequence in case a deadlock situation has occurred. It also closes down socket connections that are left open by the client and unused for more than 24 hours.

It is possible to use SMS communication while GPRS communication is active. However, in the "Connected" state the delay time between reception and reply will increase.

If the connection state is different from "Connected", it is possible to establish a call-up connection. When the call-up connection is established, GPRS data exchange will be blocked until the call-up is terminated by the caller.

A total of three Modbus clients can be connected to the Modbus TCP port of the CU 361 and communicate simultaneously. Each connection, called a socket connection, is handled independently. If all three sockets are used simultaneously, a "Silence timeout" of only 5 minutes is used to prevent a complete occupation for a long time.

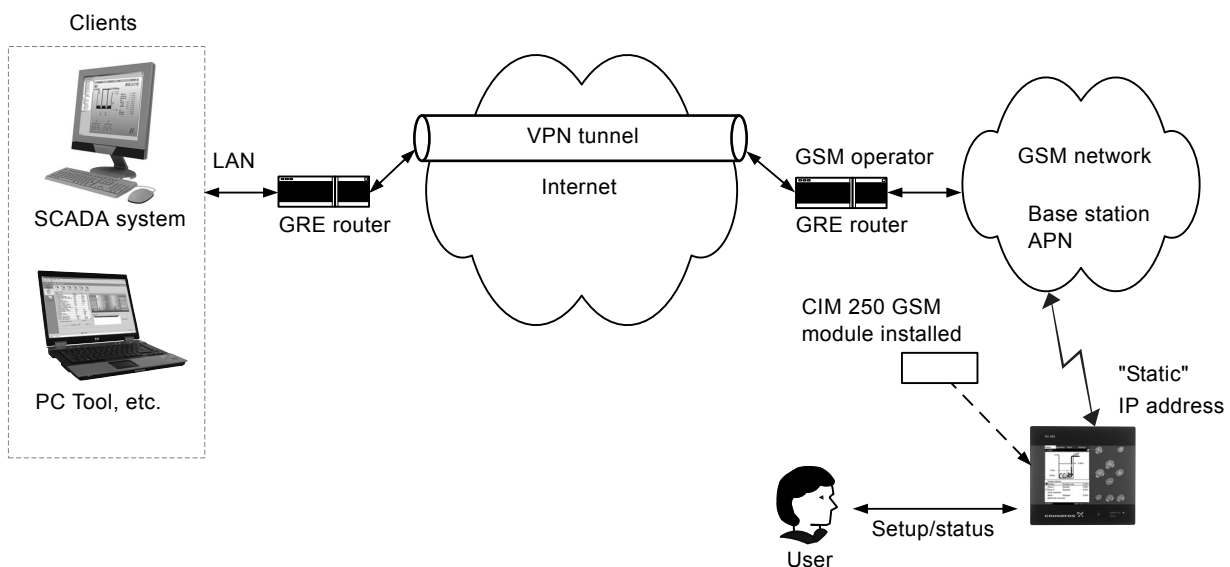


Fig. 10 GPRS via VPN tunnel

TM04 4908 2209

6.9.5 Call-back via GPRS

If an alarm appears in the Dedicated Controls wastewater system and the SCADA call-back function in the CU 361 has been enabled in general and also enabled for this particular alarm, the CIM 250 will attempt to establish a GPRS connection to the SCADA system.

If the GPRS connection state is "Connected" (one or more socket connections are established), the call-back function in the CU 361 will use the GPRS connection and perform a GPRS call-back to all clients connected to port 502. Otherwise it will use a standard GSM call-back. See section 6.7 *GSM call-back connection*.

A common standard for call-back via GPRS does not exist. In the CU 361, this function is implemented as a Modbus TCP write telegram sent from the CIM 250. See fig. 11.

Transaction ID	0x**	Has the value of the latest transaction ID minus 10
	0x**	
Protocol ID	0x00	
	0x00	
Length	0x00	
	0x06	
Slave address	0xE7	The selected slave address, here the default value is shown
Function code	0x06	Write single register
Register address	0x01	
	0x00	
Value to write	0xFF	Value 0xFF00 written to register 0x0001
	0x00	

TM04 4909 2809

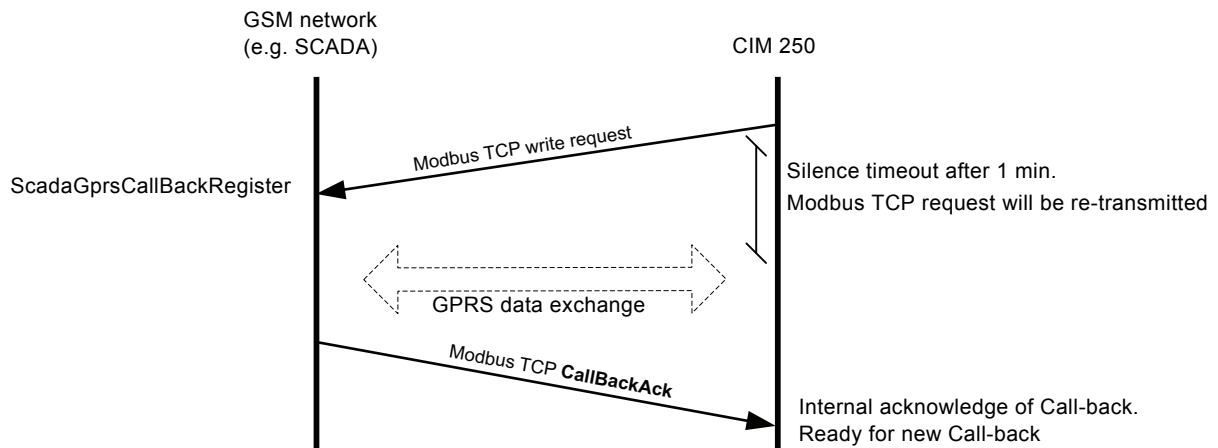
Fig. 11 Modbus TCP telegram used for call-back via GPRS

The call-back telegram is a "Write single register" function that writes the value of 0x00FF to a specific register address in the Modbus TCP master. Which register address to write to can be programmed in the ScadaGprsCallBackRegister (register 00007). In fig. 11 the address is 0x0001. The Modbus TCP master must interpret this as a call-back request from the CU 361 and start polling for data within one minute, otherwise the Modbus TCP write telegram will be resent.

The SCADA system must complete its communication with the CIM 250 by issuing a call-back acknowledgement.

If call-back is to be used, the SCADA system software (Modbus TCP driver) must support this procedure.

If more clients are "Connected" simultaneously, they will all receive the call-back, and any of them will be able to terminate the call-back sequence.



TM04 4910 2209

Fig. 12 GPRS call-back sequence

Relevant settings in the CU 361:

To find the parameter in the CU 361, go to

Settings > Communication settings > SCADA settings >

- SCADA call-back enabled.

Settings > Alarm settings > System alarms >

- SCADA call-back for particular alarms.

6.10 Interlocking

6.10.1 From SCADA system via GSM/GPRS

Interlocking can be done from a Modbus master (like a SCADA system) via the Modbus interface.

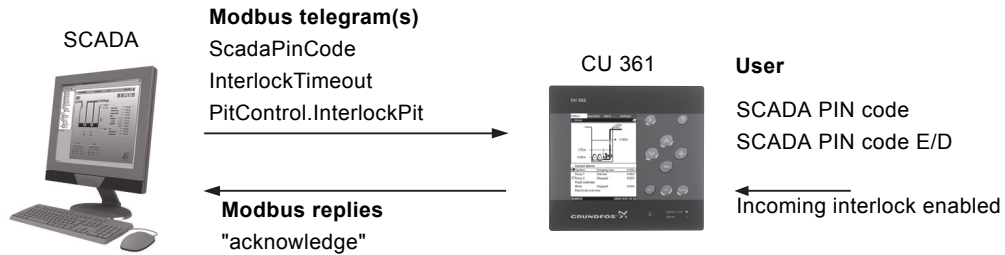


Fig. 13 Interlocking from SCADA

To find the parameter in the CU 361, go to

Settings > Communication settings > SCADA settings >

- SCADA PIN code (if PIN code protection is used).
- SCADA PIN code enabled/disabled.

Settings > Communication settings > Interlock settings >

- Incoming interlock enabled.

For further information, see installation and operating instructions for Dedicated Controls.

Interlocking procedure

1. The Modbus master (e.g. SCADA system or PLC) writes the correct SCADA PIN code to the ScadaPinCode (register 00109) if PIN code protection is enabled.

Note

The SCADA system can verify that write access is granted by reading the PitStatus.WriteAccess (register 00202, bit 5) which will be logical 1 if write access is granted.

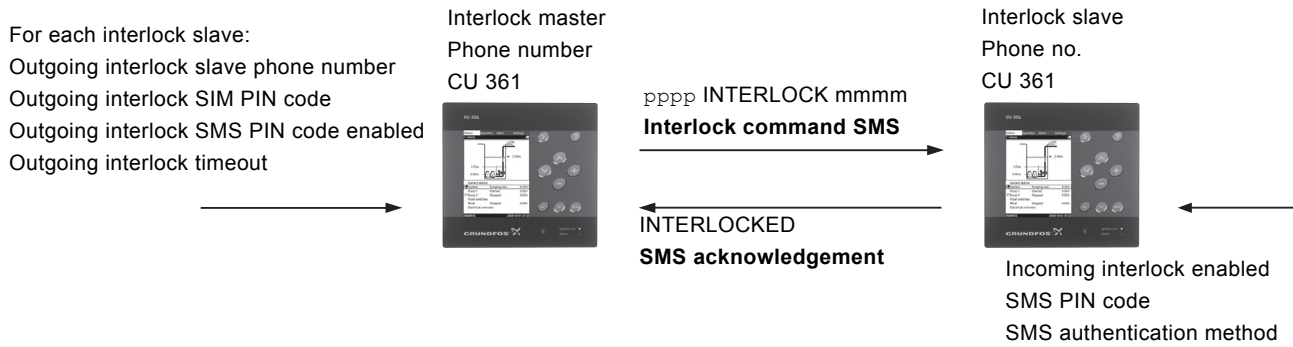
2. The CU 361 Modbus slave verifies that the written ScadaPinCode (register 00109) register value corresponds to the SCADA PIN code entered by the user (CU 361 or PC Tool WW Controls). If the codes match, the slave will accept data writing from SCADA.
3. The Modbus master writes the InterlockTimeout (register 00226) if this value should be controlled from the master application. If it is not written, the existing value will be used.
4. The Modbus master raises the interlock bit PitControl.InterlockPit (register 00101, bit 3), which will bring the CU 361 into "interlock" mode. An interlock timeout is initiated, corresponding to the current value of the InterlockTimeout (register 00226) in the Modbus profile.

Note

Whenever a rising edge PitControl.InterlockPit is generated, the interlock timeout will be reinitialised with the value of the InterlockTimeout register. This is used to prolong an interlock mode.

5. The Modbus master can any time bring the CU 361 Modbus slave back into "Auto" mode by raising the PitControl.AutoPit, register 00101, bit 4.

6.10.2 From another controller via SMS



TM04 4912 2209

Fig. 14 Interlocking from another controller

Figure 14 illustrates the CU 361 SMS interlocking mechanism. The CU 361 interlock master issues an SMS command containing a 4-digit PIN code `pppp` matching the SMS PIN code of the interlock slave CU 361. Following the PIN code is the interlock command `INTERLOCK` with an interlock timeout value `mmmm` counting in minutes. Timeout values allowed: 1-1440 min. (= 24 hours).

If the interlock is accepted (correct PIN code, correct command and valid interlock timeout value), the interlock slave will change its operating mode to "Interlock control".

The SMS PIN code in the interlock SMS command is optional if the authentication method is "Both" and the interlock master phone number is present in the interlock slave SMS phone number list.

The interlock timeout value, however, is always optional. If it is not included, the previously received value will be used.

By issuing the "Auto" command, the interlock master can instantly terminate interlocking: `"pppp AUTO"`.

The function of interlocking by SMS has the natural consequence that interlocking is also possible via a mobile phone. In this case, the user will be able to see the acknowledgement SMS (positive or negative) replied back from the CU 361.

The CU 361 interlock master can interlock up to three CU 361 interlock slaves, each represented by a set of parameters that have to be configured in the master for each of them.

To find the parameter in the CU 361, go to

Settings > Communication settings > Interlock settings > Interlock, pit 1 >

- Outgoing interlock slave phone number
- Outgoing interlock SMS PIN code
- Outgoing interlock SMS PIN code enabled
- Outgoing interlock timeout.

The interlock slave has to be configured as described in the installation and operating instructions for Dedicated Controls.

To find the parameter in the CU 361, go to

Settings > Communication settings > SMS authentication >

- SMS PIN code `pppp`
- SMS authentication method ("Via phone number", "Via PIN code", "Both" or "None").

Settings > Communication settings > Interlock settings >

- Incoming interlock enabled.

6.11 Real-time clock

The real-time clock can be set and/or read from the CU 361 in two ways: Unix format or standard format.

All time stamps in the event log and in the data log are also Unix time format. Read the time with UNIXRealTimeClockHI (register 00228) and UNIXRealTimeClockLO (register 00229), or set a new time with SetRealTimeClockHI (register 00112) and SetRealTimeClockLO (register 00113). The new time will be activated in the CU 361 when writing the LO-order register. It is recommended to write the HI/LO registers in the same telegram.

6.11.1 Unix time format

For further information, see

- http://www.devshed.com/c/a/Administration/UNIX-Time_Format_Demystified/1/
- <http://www.epochconverter.com/>

6.11.2 Standard format

In the standard format, there are registers for specifying second, minute, hour, day, month and year (offset by 2000) in a human-readable way. With registers from 00230 to 00235 the actual values can be read, and with registers 00114 to 00119 new values can be set. The new values will be activated when writing the value "1" to SetRtc (register 00120, bit 0).

6.12 Event simulation

It is possible to simulate alarm/warning events by writing appropriate values to the registers:

- Simulation.EventCode (register 00701)
- Simulation.EventSource (register 00702)
- Simulation.EventDeviceNo (register 00703)
- Simulation.EventActionType (register 00704).

and afterwards trigger the simulated event via Simulation.Activate (register 00705, bit 0). The event recording will take place as if the event was real, but the system operation will not be influenced.

The Simulation.Status (register 00706, bit 0) can be used to check if event simulation is active. If the bit value is 0, there is no active alarm simulation.

By writing a '0' to Simulation.EventCode (register 00701) and afterwards setting the Simulation.Activate (register 00705, bit 0) control bit, the simulated event is cancelled. It can also be cancelled with the PitControl.ResetAlarm (register 00101, bit 0) control bit.

Event simulation procedure

- Write a valid event code (see section [10. Grundfos alarm and warning codes](#)) to Simulation.EventCode (register 00701).
- Write an event source number (see section [6.13 Alarms and warnings](#)) to Simulation.EventSource (register 00702).
- Write a device number (see section [6.13 Alarms and warnings](#)) to Simulation.EventDeviceNo (register 00703).
- Write an action type number (see section [5.9 Simulation register block](#)) to Simulation.EventActionType (register 00704).
- Activate the alarm simulation with the above settings by writing 1 to Simulation.Activate (register 00705, bit 0).

6.13 Alarms and warnings

These registers reflect the actual alarm/warning conditions for the pit or the pump. Alarms/warnings, which have acknowledgement type "Auto-ack", will be cleared automatically when normal conditions are restored. Alarms/warnings, which have acknowledgement type "Manual-ack", require a PitControl.ResetAlarm command to be cleared.

Note Warnings use the same bit interpretation as alarms.

Description	Data item	Code	Event source
Pit alarms 1			
Overflow alarm	PitAlarms1.0	192	System
High-level alarm	PitAlarms1.1	191	System
Alarm level alarm	PitAlarms1.2	190	System
Dry-running alarm	PitAlarms1.3	57	System
Mains supply fault	PitAlarms1.4	6	System
Level float switch sequence inconsistency	PitAlarms1.5	205	System
Inconsistency between float switches and sensor	PitAlarms1.6	204	System
Level/pressure sensor signal fault	PitAlarms1.7	168	AI (level sensor)
Flow sensor signal fault	PitAlarms1.8	169	AI (flow sensor)
Power meter sensor signal fault	PitAlarms1.9	186	AI (power sensor)
Mixer contactor feedback fault	PitAlarms1.10	221	DI (mixer contactor)
Distributed I/O module communication fault	PitAlarms1.11	226	IO 351
Add-on CIM communication fault	PitAlarms1.12	159	Add-on CIM
SIM card fault	PitAlarms1.13	160	Add-on CIM
SCADA call-back fault	PitAlarms1.14	15	System
Power-on occurred	PitAlarms1.15	247	System
Pit alarms 2			
Battery/UPS fault	PitAlarms2.0	248	Battery/UPS
Hardware fault (general)	PitAlarms2.1	72	CU 361/IO 351
Ethernet: No IP address from DHCP server	PitAlarms2.2	231	System
Ethernet: Auto-disabled due to misuse	PitAlarms2.3	232	System
Time for service, mixer	PitAlarms2.4	222	Mixer
Maximum number of mixer starts per hour exceeded	PitAlarms2.5	223	System
User-defined relay activated	PitAlarms2.6	246	CU 361
External fault	PitAlarms2.8	3	System
Combi alarm No. 1	PitAlarms2.9	227	System
Combi alarm No. 2	PitAlarms2.10	227	System
Combi alarm No. 3	PitAlarms2.11	227	System
Combi alarm No. 4	PitAlarms2.12	227	System
Pit alarms 3			
RESERVED	PitAlarms3.0-15	–	–
Pump alarms 1			
Motor temperature alarm, PTC1	PumpAlarms1.0	69	IO 111, pump No. [1; 2]
Motor temperature alarm, PTC2	PumpAlarms1.1	70	IO 351/MP 204, pump No. [1; 2]
Motor stator temperature high (T1, Pt1000/Pt100)	PumpAlarms1.2	64	IO 111, pump No. [1; 2]
Motor stator temperature high (T2, Pt1000/Pt100)	PumpAlarms1.3	71	MP 204, pump No. [1; 2]
Motor support bearing temperature high (Pt100)	PumpAlarms1.4	145	IO 111, pump No. [1; 2]
Motor main bearing temperature high (Pt100)	PumpAlarms1.5	146	IO 111, pump No. [1; 2]
Motor insulation resistance low	PumpAlarms1.6	20	IO 111, pump No. [1; 2]
Motor low voltage (no voltage)	PumpAlarms1.7	40	MP 204, pump No. [1; 2]
Motor high voltage	PumpAlarms1.8	32	MP 204, pump No. [1; 2]
Motor phase sequence reversal	PumpAlarms1.9	9	MP 204, pump No. [1; 2]
Motor overload (maximum current)	PumpAlarms1.10	48	AI/MP 204, pump No. [1; 2]
Motor underload (minimum current)	PumpAlarms1.11	56	AI/MP 204, pump No. [1; 2]
Motor protector test trip	PumpAlarms1.12	27	DI/MP 204, pump No. [1; 2]
Motor missing phase	PumpAlarms1.13	2	MP 204, pump No. [1; 2]
Motor current asymmetry	PumpAlarms1.14	111	MP 204, pump No. [1; 2]
Load continues even if the motor relay is off	PumpAlarms1.15	26	MP 204, pump No. [1; 2]

Description	Data item	Code	Event source
Pump alarms 2			
Motor protector activated	PumpAlarms2.0	18 or 27	DI, pump No. [1; 2]
Common phase error	PumpAlarms2.1	241	DI, pump No. [1; 2]
Motor moisture switch	PumpAlarms2.2	22	IO 111, pump No. [1; 2]
Motor/pump vibration high	PumpAlarms2.3	24	IO 111, pump No. [1; 2]
Motor water-in-oil content too high (water in oil)	PumpAlarms2.4	11	AI/IO 111, pump No. [1; 2]
Motor fault in mains supply	PumpAlarms2.5	6	DI, pump No. [1; 2]
Motor contactor feedback fault	PumpAlarms2.6	220	DI, pump No. [1; 2]
Motor max. starts per hour limit exceeded	PumpAlarms2.7	21	System, pump No. [1; 2]
Motor operating time service limit exceeded	PumpAlarms2.8	12	Pump No. [1; 2]
Too many pump auto-restarts (per 24 h)	PumpAlarms2.9	4	MP 204, pump No. [1; 2]
Pump low flow	PumpAlarms2.10	58	Pump No. [1; 2]
Pump max. continuous runtime limit exceeded	PumpAlarms2.11	245	System, pump No. [1; 2]
Motor cos φ too high	PumpAlarms2.12	112	MP 204, pump No. [1; 2]
Motor cos φ too low	PumpAlarms2.13	113	MP 204, pump No. [1; 2]
Pump alarms 3			
Pump malfunction due to auxiliary component fault	PumpAlarms3.0	224	Pump No. [1; 2]
Distributed pump module communication fault	PumpAlarms3.1	225	IO 111, pump No. [1; 2]
On/Off/Auto switch fault	PumpAlarms3.2	244	DI, pump No. [1; 2]
Pt100 sensor signal fault	PumpAlarms3.3	175	IO 111/MP 204, pump No. [1; 2]
PTC sensor signal fault	PumpAlarms3.4	181	IO 111, pump No. [1; 2]
Water-in-oil (WIO) sensor signal fault	PumpAlarms3.5	170	AI, pump No. [1; 2]
Motor support bearing temperature sensor signal fault	PumpAlarms3.6	179	IO 111, pump No. [1; 2]
Motor main bearing temperature sensor signal fault	PumpAlarms3.7	180	IO 111, pump No. [1; 2]
Pump (powerline) communication fault	PumpAlarms3.8	10	IO 111, pump No. [1; 2]
Setup conflict	PumpAlarms3.9	25	IO 111, pump No. [1; 2]
General hardware fault	PumpAlarms3.10	72	IO 111/MP 204, pump No. [1; 2]

7. Commissioning

7.1 Step-by-step guide to hardware setup (CIM 250)

Step	Action
1	Fit the CIM 250 in the CU 361. Secure it with screws.
2	Complete the CU 361 configuration (e.g. sensor configuration). This can be done either via the CU 361 control panel or with the Grundfos PC Tool WW Controls.
3	Confirm that the GENibus LED2 is permanently green and that the GSM/GPRS LED1 is pulsating yellow (if no master is actively polling the slave).
The CIM 250 is now ready to be accessed via the GSM/GPRS network.	

7.2 Quick guide to communication

This quick guide will show how to read pit water level and pit operating mode, read pit alarm bits, interlock the pit and set it back to auto mode, all in simple steps.

Step	Description
1	Complete the commissioning steps in section 7.1 Step-by-step guide to hardware setup (CIM 250) for hardware setup.
2	Verify that the Modbus communication has been established, e.g. by using Modbus function code 0x08 (Diagnostics) subcode 0x00 (Return Query Data) and ensuring that the response is equal to the request. See section 13.1 Diagnostics: return query data for details.
3	Read register address 00301 with Modbus function code 0x03 (Read Holding Registers) to read the actual water level from the pit. This value is scaled in 0.01 m, e.g. a value of 100 equals 1 m.
4	Read register address 00203 with Modbus function code 0x03 (Read Holding Registers) to read the actual operating mode of the pit. This is an enumerated value. See section 5.5 Pit status register block for details.
5	Read register addresses 00210, 00211, 00212 with Modbus function code 0x03 (Read Holding Registers) to get the alarm bits from the pit. See section 5.5 Pit status register block for interpretation of the bits.
6	Read register address 00202 with Modbus function code 0x03 (Read Holding Registers), and ensure that bit 4 (ScadaPinCodeEnabled) has the value of '0'. If this is not the case, the correct PIN code must be set with ScadaPinCode (register 00109).
7	To interlock the pit, set register 00201, bit 3, to value '1' with Modbus function code 0x06 (Write single register). This control bit will set the pit to interlock mode for as many minutes as the value InterlockTimeout (register 00226) states. If Config.AutoAckControlBits (register 00005, bit 0) has value '1' (default), bit 3, in register 00201 will automatically revert to value '0' after it has been acknowledged by the CIM 250.
8	To set the pit back to "Auto" mode, set register 00201 bit 4 to value '1' with Modbus function code 0x06 (Write single register). If Config.AutoAckControlBits (register 00005, bit 0) has value '1' (default), bit 4, in register 00201 will automatically revert to value '0' after it has been acknowledged by the CIM 250.

8. Fault finding

Faults in a CIM 250 GSM module can be detected by observing the status of the two communication LEDs. See the table below and section [3.2 LEDs](#).

8.1 LED status

CIM 250 fitted in the CU 361

Fault (LED status)	Possible cause	Remedy
1. Both LEDs (LED1 and LED2) remain off when the power supply is connected.	a) The CIM 250 is fitted incorrectly in the CU 361.	Ensure that the CIM 250 is fitted correctly in the CU 361.
	b) The CIM 250 is defective.	Replace the CIM 250.
2. The LED for internal communication (LED2) is flashing red.	a) No internal communication between the CIM 250 and the CU 361.	Ensure that the CIM 250 is fitted correctly in the v.
3. The LED for internal communication (LED2) is permanently red.	a) The CIM 250 does not support the connected CU 361.	Contact the nearest Grundfos company.
	b) The CIM 250 is defective.	Replace the CIM 250.
4. The LED for GSM/GPRS communication (LED1) is flashing yellow.	a) The SIM card has not been inserted.	Insert the SIM card. See section 3.1.2 Inserting the SIM card .
	b) The SIM card has not been inserted correctly.	Insert the SIM card. See section 3.1.2 Inserting the SIM card .
	c) The SIM card PIN code is not correct.	Enter the correct PIN code. See section 3.1.2 Inserting the SIM card .
	d) No connection to the GSM network.	• Check the connection to the aerial. • Check the GSM coverage of the area with for instance a mobile phone. • Use an external aerial, and experiment with the position.
5. The LED for GSM/GPRS communication is pulsating yellow with single pulse, but the CIM 250 cannot send or receive SMS messages.	a) The CIM 250 has not been initialised.	Settings > Communication settings > • SMS numbers • SMS schedule • SMS authentication.

8.2 Modbus GSM/GPRS communication faults

Fault	Possible cause	Remedy
1. The slave does not respond to telegrams.	a) Configuration or installation error.	- Ensure that the CIM 250 has contact with the GSM network. The LED1 should be pulsing yellow. - If the LED1 signal is incorrect, see section 3. CIM 250 GSM module for correct installation of the CIM 250. - Ensure that the correct slave address is used in the Modbus master poll. See register 00003 ModbusAddress (factory value is 00231).
	b) The slave may be in Listen-Only mode.	Either send a restart communications diagnostics command, or restart the CU 361 manually.
	c) If the holding register of address 00001 "SlaveMinimumReplyDelay" is set too high, the master may time out before receiving the response from the slave.	Increase the reply delay in the master or reduce the "SlaveMinimumReplyDelay" in order to communicate.
2. The slave responds with exception response 0x01: "Invalid function".	a) The master is trying to use an unsupported function in the CIM 250.	See section 4. Modbus function code overview for supported function codes. Note that reading and writing coils are not supported, so only register functions and diagnostics will be valid.
3. The slave responds with exception response 0x02: "Invalid data address".	a) The master is trying to read or write an invalid data address. If a master tries to read register addresses that are not listed in the tables, the slave will respond with this exception response. Some masters may automatically try to read large blocks in one telegram, which will cause problems if some of the registers in the block are not supported. An example would be reading the Device Config and Device Status blocks in one telegram: this is not possible since there are unused addresses among the blocks.	Avoid reading or writing invalid data addresses.
4. The slave returns data value 0xFFFF (65535).	a) The value is unavailable. A data value of 0xFFFF does not necessarily indicate an error condition. It means that the value is unavailable from the CU 361.	See section 9. Data item overview for available data.
	b) The CU 361 is not configured to show the value or lacks a sensor to read the value.	See section 5.6 Pit data register block for data values that require a sensor.

9. Data item overview

Explanation to abbreviations used for scaling

bits	The data item is bit-interpreted.
enum	The data item has a pre-defined enumeration.
unscaled	The data item is unscaled (for instance a number, a counter, etc.).
bool	The data item is boolean variable.
UTF-8	Unicode transformation format (character encoding).
log	Log data.
...	Indicates variable register address.

Address	Identifier	Scaling	R/W	Description
CIM Config Register Block				
00001	SlaveMinimumReplyDelay	1 ms	R/W	Minimum Modbus reply delay in ms
00002	RESERVED	–	–	–
00003	ModbusAddress	unscaled	R/W	Software-defined node address
00004	ModbusBitRate	unscaled	R/W	Software-defined bit rate
00005	AutoAcknowledgeEvents	bits	R/W	Selects event acknowledgement behaviour
00006	ReadWriteSeparation	bits	R/W	Selects read-back value behaviour
00007	ScadaGprsCallBackRegister	unscaled	R/W	Selects register to be used for GPRS call-back. See fig. 12.
CIM Status Register Block				
00021	GENIbusCRCErrorCnt	unscaled	R	Grundfos GENIbus CRC error counter
00022	GENIbusDataErrorCnt	unscaled	R	Grundfos GENIbus data error counter
00023	VersionNumber	unscaled	R	Software version number
00024	ActualModbusAddress	unscaled	R	Actual Modbus slave address
00025	GrundfosTXcountHI	unscaled	R	Grundfos GENIbus TX counter
00026	GrundfosTXcountLO			
00027	GrundfosRXcountHI	unscaled	R	Grundfos GENIbus RX counter
00028	GrundfosRXcountLO			
Pit Control & Configuration Register Block				
00101	PitControl	bits	R/W	Register for pit control
00102	CustomRelay	bool	R/W	Sets the value of the custom relay
00103	PitPump1Control	bits	R/W	Register for pit pump control
00104	PitPump2Control	bits	R/W	Register for pit pump control
00109	ScadaPinCode	unscaled	R/W	PIN code for SCADA systems, etc.
00110	SetEventLogClearID	unscaled	R/W	Records to clear in the event log
00111	SetInterlockTimeout	1 min.	R/W	Interlock timeout value
00112	SetRealTimeClockHI	1 s	R/W	For setting a new real-time clock value in the CU 361
00113	SetRealTimeClockLO			
00114	SetRtcSecond	enum	R/W	Second of the minute [0; 59]
00115	SetRtcMinute	enum	R/W	Minute of the hour [0; 59]
00116	SetRtcHour	enum	R/W	Hour of the day [0; 23]
00117	SetRtcDay	enum	R/W	Day of the month [1; 31]
00118	SetRtcMonth	enum	R/W	Month of the year [1; 12]
00119	SetRtcYear	enum	R/W	Year [0; 65535], e.g. 2008
00120	SetRtc	bool	R/W	Control bit to set the real-time clock to the values in registers 00114-00119
00121	SetOverflowLevel	0.01 m	R/W	Set level for overflow level alarm
00122	SetHighLevel	0.01 m	R/W	Set level for high-level alarm
00123	SetAlarmLevel	0.01 m	R/W	Set level for alarm level alarm
00124	SetDryRunningLevel	0.01 m	R/W	Set level for dry-running alarm
00125	SetFoamDrainingLevel	0.01 m	R/W	Set level for foam-draining stop
00126	SetStartLevelPump1	0.01 m	R/W	Set start level for the first pump
00127	SetStopLevelPump1	0.01 m	R/W	Set stop level for the first pump
00128	SetStartLevelPump2	0.01 m	R/W	Set start level for the second pump
00129	SetStopLevelPump2	0.01 m	R/W	Set stop level for the second pump

Address	Identifier	Scaling	R/W	Description
00138	UserLabel1	unscaled	R/W	Register area for device labelling
00139	UserLabel2	unscaled	R/W	Register area for device labelling
00140	UserLabel3	unscaled	R/W	Register area for device labelling
00141-00187	UserLabel4... UserLabel49	unscaled	R/W	Register area for device labelling
00188	UserLabel50	unscaled	R/W	Register area for device labelling
Pit Status Register Block				
00201	ControlBitAck	bits	R	Used if manual acknowledgement is enabled
00202	PitStatusRegister	bits	R	Register for pit status
00203	OperatingMode	enum	R	Mode of pit operation
00204	PitPumpsPresence	bits	R	Presence state of pit pumps
00205	PitPumpsDisabled	bits	R	Disabled state of pit pumps
00206	PitPumpsRunning	bits	R	Running state of pit pumps
00207	PitPumpsMonitorFault	bits	R	Monitoring state of pit pumps
00208	PitPumpsWarning	bits	R	Warning state of pit pumps
00209	PitPumpsAlarm	bits	R	Alarm state of pit pumps
00210	PitAlarms1	bits	R	Pit alarm events, item 1
00211	PitAlarms2	bits	R	Pit alarm events, item 2
00212	PitAlarms3	bits	R	Pit alarm events, item 3
00213	PitWarnings1	bits	R	Pit warning events, item 1
00214	PitWarnings2	bits	R	Pit warning events, item 2
00215	PitWarnings3	bits	R	Pit warning events, item 3
00216	EventLogLatestID	unscaled	R	ID of the latest event record
00217	NumberOfFloatSwitches	unscaled	R	Number of installed float switches
00218	FloatSwitchesStatus	bits	R	On/off state of float switches
00219	FloatSwitch1Function	enum	R	Function of float switch 1
00220	FloatSwitch2Function	enum	R	Function of float switch 2
00221	FloatSwitch3Function	enum	R	Function of float switch 3
00222	FloatSwitch4Function	enum	R	Function of float switch 4
00223	FloatSwitch5Function	enum	R	Function of float switch 5
00224	PitSensors	bits	R	Which system sensors are present
00225	DayCounterZeroTime	enum	R	Zero time for counters
00226	InterlockTimeout	1 min.	R	Actual interlock timeout value
00227	RESERVED	–	–	–
00228	RealTimeClockHI	1 s	R	Actual real-time clock
00229	RealTimeClockLO			
00230	RtcSecond	enum	R	Second of the minute [0; 59]
00231	RtcMinute	enum	R	Minute of the hour [0; 59]
00232	RtcHour	enum	R	Hour of the day [0; 23]
00233	RtcDay	enum	R	Day of the month [1; 31]
00234	RtcMonth	enum	R	Month of the year [1; 12]
00235	RtcYear	enum	R	Year [0; 254] = [year 2000; year 2254]
00236	GSMSignalLevelActual	1 %	R	Actual value of GSM signal level
00237	GSMSignalLevelAverage	1 %	R	Average value of GSM signal level
00238	IPAddressHI	unscaled	R	High-order part of IP address (GPRS only)
00239	IPAddressLO	unscaled	R	Low-order part of IP address (GPRS only)
00240	OverflowLevel	0.01 m	R	Level for overflow level alarm
00241	HighLevel	0.01 m	R	Level for high-level alarm
00242	AlarmLevel	0.01 m	R	Level for alarm level alarm
00243	DryRunningLevel	0.01 m	R	Level for dry-running alarm
00244	FoamDrainingLevel	0.01 m	R	Level for foam-draining stop
00245	StartLevelPump1	0.01 m	R	Start level for the first pump
00246	StopLevelPump1	0.01 m	R	Stop level for the first pump
00247	StartLevelPump2	0.01 m	R	Start level for the second pump
00248	StopLevelPump2	0.01 m	R	Stop level for the second pump

Address	Identifier	Scaling	R/W	Description
Pit Data Register Block				
00301	PitWaterLevel	0.01 m	R	Sensor-measured water level in the pit
00302	PitSwitchWaterLevel	enum	R	Float-switch-detected water level in the pit
00303	PitDepth	0.01 m	R	Depth of the pit
00304	PitFlowIn	0.1 l/s	R	Actual flow into the pit
00305	PitAverageFlowIn	0.1 l/s	R	Average flow into the pit
00306	PitFlowOut	0.1 l/s	R	Actual flow out of the pit
00307	PitAverageFlowOut	0.1 l/s	R	Average flow out of the pit
00308	PitPowerHI	1 W	R	Power consumption of the pit
00309	PitPowerLO			
00310	PitEnergyHI			
00311	PitEnergyLO	0.1 kWh	R	Energy consumption of the pit
00312	PitEnergyYesterday	0.1 kWh	R	Energy consumption of the pit yesterday
00313	PitEnergyToday	0.1 kWh	R	Energy consumption of the pit today
00314	PitSpecificEnergy	1 Wh/m ³	R	Specific energy consumption of the pit
00315	PitPumpedVolumeHI	0.1 m ³	R	Total pumped volume
00316	PitPumpedVolumeLO			
00317	PitPumpedVolumeYesterday			
00318	PitPumpedVolumeToday	0.1 m ³	R	Total pumped volume today
00319	PitMixerAvgStartsPerHour	unscaled	R	Average number of mixer starts per hour
00320	PitOverflowVolume	0.1 m ³	R	Pit overflow volume
00321	PitOverflowVolumeYesterday	0.1 m ³	R	Pit overflow volume yesterday
00322	PitOverflowVolumeToday	0.1 m ³	R	Pit overflow volume today
00323	PitOverflowTime	1 min.	R	Pit overflow time
00324	PitOverflowTimeYesterday	1 min.	R	Pit overflow time yesterday
00325	PitOverflowTimeToday	1 min.	R	Pit overflow time today
00326	PitOverflowCounter	unscaled	R	Number of pit overflows
00327	PitOverflowCounterYesterday	unscaled	R	Number of pit overflows yesterday
00328	PitOverflowCounterToday	unscaled	R	Number of pit overflows today
00329	PitOperatingTimeHI	1 min.	R	Total pit operating time (power-on time)
00330	PitOperatingTimeLO			
00331	Pit2PumpsOprTimeHI			
00332	Pit2PumpsOprTimeLO	1 min.	R	Total operating time (two pumps operating simultaneously)
00333	Pit2PumpsOprTimeYesterday	1 min.	R	Operating time yesterday (two pumps operating simultaneously)
00334	Pit2PumpsOprTimeToday	1 min.	R	Operating time today (two pumps operating simultaneously)
00351	UserAnalog1	0.1 %	R	User-defined measurement on analog input 1
00352	UserAnalog2	0.1 %	R	User-defined measurement on analog input 2
00353	UserAnalog3	0.1 %	R	User-defined measurement on analog input 3
Pump 1 – data and status register block				
00401	Pump1Status	bits	R	Status register for the pump
00402	Pump1ControlSource	enum	R	Pump control source
00403	Pump1ConnectionType	enum	R	Pump connection type
00404	Pump1OprTimeHI	1 min.	R	Total operating time
00405	Pump1OprTimeLO			
00406	Pump1TimeToServiceHI			
00407	Pump1TimeToServiceLO	1 min.	R	Time to next service
00408	Pump1OprTimeYesterday	1 min.	R	Operating time yesterday
00409	Pump1OprTimeToday	1 min.	R	Operating time today
00410	Pump1LatestOprTime	1 s	R	Operating time last time it was operated
00411	Pump1StartCounterHI	unscaled	R	Total number of pump starts
00412	Pump1StartCounterLO			
00413	Pump1StartCounterYesterday			
00414	Pump1StartCounterToday	unscaled	R	Total number of pump starts today
00415	Pump1AvgStartsPerHour	unscaled	R	Average number of pump starts per hour
00416	Pump1Flow	0.1 l/s	R	Calculated or measured pump flow

Address	Identifier	Scaling	R/W	Description
00417	Pump1LatestFlow	0.1 l/s	R	Latest calculated/measured flow (capacity)
00418	Pump1Current	0.1 A	R	Motor current
00419	Pump1LatestCurrent	0.1 A	R	Latest motor current
00420	RESERVED	–	–	–
00421	Pump1Insulation	10 kΩ	R	Motor insulation resistance
00422	Pump1WaterInOil	0.1 %	R	Motor water-in-oil measurement
00423	Pump1Alarms1	bits	R	Pump alarms, item 1
00424	Pump1Alarms2	bits	R	Pump alarms, item 2
00425	Pump1Alarms3	bits	R	Pump alarms, item 3
00426	Pump1Warnings1	bits	R	Pump warnings, item 1
00427	Pump1Warnings2	bits	R	Pump warnings, item 2
00428	Pump1Warnings3	bits	R	Pump warnings, item 2
00429	Pump1MotorTemperature1	1 °C	R	Motor temperature 1
Pump 2 – data and status register block				
00451	Pump2Status	bits	R	Status register for the pump
00452	Pump2ControlSource	enum	R	Pump control source
00453	Pump2ConnectionType	enum	R	Pump connection type
00454	Pump2OperatingTimeHI	1 min.	R	Total operating time
00455	Pump2OperatingTimeLO			
00456	Pump2TimeToServiceHI	1 min.	R	Time to next service
00457	Pump2TimeToServiceLO			
00458	Pump2OperatingTimeYesterday	1 min.	R	Operating time yesterday
00459	Pump2OperatingTimeToday	1 min.	R	Operating time today
00460	Pump2LatestOperatingTime	1 s	R	Operating time last time it was operated
00461	Pump2StartCounterHI	unscaled	R	Total number of pump starts
00462	Pump2StartCounterLO			
00463	Pump2StartCounterYesterday	unscaled	R	Total number of pump starts yesterday
00464	Pump2StartCounterToday	unscaled	R	Total number of pump starts today
00465	Pump2AvgStartsPerHour	unscaled	R	Average number of pump starts per hour
00466	Pump2Flow	0.1 l/s	R	Calculated or measured pump flow
00467	Pump2LatestFlow	0.1 l/s	R	Latest calculated/measured flow (capacity)
00468	Pump2Current	0.1 A	R	Motor current
00469	Pump2LatestCurrent	0.1 A	R	Latest motor current
00470	RESERVED	–	–	–
00471	Pump2Insulation	10 kΩ	R	Motor insulation resistance
00472	Pump2WaterInOil	0.1 %	R	Motor water-in-oil measurement
00473	Pump2Alarms1	bits	R	Pump alarms, item 1
00474	Pump2Alarms2	bits	R	Pump alarms, item 2
00475	Pump2Alarms3	bits	R	Pump alarms, item 3
00476	Pump2Warnings1	bits	R	Pump warnings, item 1
00477	Pump2Warnings2	bits	R	Pump warnings, item 2
00478	Pump2Warnings3	bits	R	Pump warnings, item 2
00479	Pump2MotorTemperature1	1 °C	R	Motor temperature 1
Event Simulation				
00701	Simulation.EventCode	enum	R/W	Event code to simulate
00702	Simulation.EventSource	enum	R/W	Source of simulated event
00703	Simulation.EventDeviceNo	enum	R/W	Event device number
00704	Simulation.Activate	bool	W	Activate/deactivate simulation
00705	Simulation.Status	bool	R	Actual simulation state
User Registers				
00751-00800	UserRegisterArea	unscaled	R/W	Register area for e.g. device labelling by the user
Display Name String				
00801-00920	NameRegisterArea	UTF-8	R	Name string read from the CU 361

Address	Identifier	Scaling	R/W	Description
Hour Log				
02001	PitOverflowTimeLog1...72	Log	R	Pit, incremental overflow time, hour log 1...72
02073	PitOverflowCntHourLog1...72	Log	R	Pit, incremental number of overflows, hour log 1...72
02145	PitOverflowVolumeHourLog1...72	Log	R	Pit, incremental overflow volume, hour log 1...72
02217	PitSpecificEnergyHourLog1...72	Log	R	Pit, specific energy, hour log 1...72
02289	PitVolumeHourLog1...72	Log	R	Pit, incremental pumped volume, hour log 1...72
02361	PitEnergyHourLog1...72	Log	R	Pit, incremental energy consumption, hour log 1...72
02433	Pit2PumpsOprTimeHourLog1...72	Log	R	Pit, incremental operating time (two pumps operating simultaneously), hour log 1...72
02793	Pump1OprTimeHourLog1...72	Log	R	Pump 1, incremental operating time, hour log 1...72
02865	Pump1StartCntHourLog1...72	Log	R	Pump 1, incremental number of starts, hour log 1...72
02937	Pump1AvgFlowHourLog1...72	Log	R	Pump 1, average flow, hour log 1...72
03009	Pump1AvgCurrentHourLog...72	Log	R	Pump 1, average current, hour log 1...72
03081	Pump2OprTimeHourLog1...72	Log	R	Pump 2, incremental operating time, hour log 1...72
03153	Pump2StartCntHourLog1...72	Log	R	Pump 2, incremental number of starts, hour log 1...72
03225	Pump2AvgFlowHourLog1...72	Log	R	Pump 2, average flow, hour log 1...72
03297	Pump2AvgCurrentHourLog1...72	Log	R	Pump 2, average current, hour log 1...72
Event Log				
06001	NoOfEventsInLog	Log	R	Number of events in the event log
06002	EventIDLog1	Log	R	Event ID for logged event No. 1 (latest event)
06003	EventCodeLog1	Log	R	Event code for logged event No. 1
06004	EventSourceLog1	Log	R	Event source for logged event No. 1
06005	EventDeviceNo	Log	R	Device number related to the event or its recognition
06006	EventTypeAndConditionLog1	Log	R	Event type and condition for logged event No. 1
06007	EventTimeStampLog1HI	Log	R	Seconds since midnight January 1st 1970 (UNIX time)
06008	EventTimeStampLog1LO	Log		
06009	EventIDLog2	Log	R	Event ID for logged event No. 2
06010	EventCodeLog2	Log	R	Event code for logged event No. 2
06011	EventSourceLog2	Log	R	Event source for logged event No. 2
06012	EventDeviceNo	Log	R	Device number related to the event or its recognition
06013	EventTypeAndConditionLog2	Log	R	Event type and condition for logged event No. 2
06014	EventTimeStampLog2HI	Log	R	Seconds since midnight January 1st 1970 (UNIX time)
06015	EventTimeStampLog2LO	Log		
List continues for events 3 to 49				
06345	EventIDLog50	Log	R	Event ID for logged event No. 50 (oldest event)
06346	EventCodeLog50	Log	R	Event code for logged event No. 50
06347	EventSourceLog50	Log	R	Event source for logged event No. 50
06348	EventDeviceNo	Log	R	Device number related to the event or its recognition
06349	EventTypeAndConditionLog50	Log	R	Event type and condition for logged event No. 50
06350	EventTimeStampLog50HI	Log	R	Seconds since midnight January 1st 1970 (UNIX time)
06351	EventTimeStampLog50LO	Log		
Data Log Header				
07001	NoOfLogSeries	unscaled	R	Number of log series L [0; 64]
07002	LogSeries1ItemNo	unscaled	R	Log series 1 item number
07003	LogSeries1RegAddr	unscaled	R	Register start address of log series 1
07004	LogSeries1SamplingTime	1 s	R	Time period between samples in log series 1, configurable on the CU 361 control panel
07005	LogSeries1NoOfSamples	unscaled	R	Number of samples in log series 1, N ₁ , configurable on the CU 361 control panel
07006	LogSeries2ItemNo	unscaled	R	Log series 2 item number
07007	LogSeries2RegAddr	unscaled	R	Register start address of log series 2
07008	LogSeries2SamplingTime	1 s	R	Time period between samples in log series 2, configurable on the CU 361 control panel
07009	LogSeries2NoOfSamples	unscaled	R	Number of samples in log series 2, N ₂ , configurable on the CU 361 control panel
...	LogSeries#ItemNo	unscaled	R	Log series # item number
...	LogSeries#RegAddr	unscaled	R	Register start address of log series #

Address	Identifier	Scaling	R/W	Description
...	LogSeries#SamplingTime	1 s	R	Time period between samples in log series #
...	LogSeries#NoOfSamples	unscaled	R	Number of samples in log series #, $N_{\#}$
07254	LogSeriesLItemNo	unscaled	R	Log series L item number (last series)
07255	LogSeriesLRegAddr	unscaled	R	Register start address of log series L
07256	LogSeriesLSamplingTime	1 s	R	Time period between samples in log series L
07257	LogSeriesLNoOfSamples	unscaled	R	Number of samples in log series L, N_L
07258	LogSeriesEndMark	unscaled	R	Log series header end mark (= 0)
Data Log Series				
07259	LogSeries1ItemNo	unscaled	R	Log series 1 item number
07260	LogSeries1SamplingTime	1 s	R	Log series 1 sampling time
07261	LogSeries1NoOfSamples	unscaled	R	Log series 1 number of samples
07262	LogSeries1TimeStampHI	1 s	R	Log series 1 UNIX time stamp
07263	LogSeries1TimeStampLO			
07264	LogSeries1Sample1	0.01 m	R	First sample of log series 1
...	...		R	
...	LogSeries1SampleN1	0.01 m	R	Last sample of log series 1
...	LogSeries2ItemNo	unscaled	R	Log series 2 item number
...	LogSeries2SamplingTime	1 s	R	Time period between samples in log series 2
...	LogSeries2NoOfSamples	unscaled	R	Log series 2 number of samples
...	LogSeries2TimeStampHI	1 s	R	Log series 2 UNIX time stamp
...	LogSeries2TimeStampLO			
...	LogSeries2Sample1	0.1 A	R	First sample of log series 2
...	...		R	
...	LogSeries2SampleN2	0.1 A	R	Last sample of log series 2
...	LogSeries#ItemNo	unscaled	R	Log series # item number
...	LogSeries#SamplingTime	1 s	R	Time period between samples in log series #
...	LogSeries#NoOfSamples	unscaled	R	Log series # number of samples
...	LogSeries#TimeStampHI	1 s	R	Log series # UNIX time stamp
...	LogSeries#TimeStampLO			
...	LogSeries#Sample1	0.1 A	R	First sample of log series #
...	...		R	
...	LogSeries#SampleN#	0.1 A	R	Last sample of log series #
...	LogSeriesLItemNo	unscaled	R	Log series L item number
...	LogSeriesLSamplingTime	1 s	R	Time period between samples in log series L
...	LogSeriesLNoOfSamples	unscaled	R	Log series L number of samples
...	LogSeriesLTimeStampHI	1 s	R	Log series L UNIX time stamp
...	LogSeriesLTimeStampLO			
...	LogSeriesLSample1	0.1 A	R	First sample of log series L
...	...		R	
...	LogSeriesLSampleNL	0.1 A	R	Last sample of log series L

10. Grundfos alarm and warning codes

This is a list of general Grundfos alarm and warning codes. Not all codes are available in the CU 361.

Code	Description	Code	Description	Code	Description
1	Leakage current	35	Gas in pump head, deaerating problem	76	Internal communication fault
2	Missing phase	36	Discharge valve leakage	77	Communication fault, twin-head pump
3	External fault signal	37	Suction valve leakage	78	Fault, speed plug
4	Too many restarts	38	Vent valve defective	79	Functional fault, add-on module
5	Regenerative braking	40	Undervoltage	80	Hardware fault, type 2
6	Mains fault	41	Undervoltage transient	81	Verification error, data area (RAM)
7	Too many hardware shutdowns	42	Cut-in fault (dV/dt)	82	Verification error, code area (ROM, FLASH)
8	PWM switching frequency reduced	45	Voltage asymmetry	83	Verification error, FE parameter area (EEPROM)
9	Phase sequence reversal	48	Overload	84	Memory access error
10	Communication fault, pump	49	Overcurrent (i_line, i_dc, i_mo)	85	Verification error, BE parameter area (EEPROM)
11	Water-in-oil fault (motor oil)	50	Motor protection function, general shutdown (mpf)	88	Sensor fault
12	Time for service (general service information)	51	Blocked motor/pump	89	Signal fault, (feedback) sensor 1
13	Moisture alarm, analog	52	Motor slip high	90	Signal fault, speed sensor
14	Electronic DC-link protection activated (ERP)	53	Kipped motor	91	Signal fault, temperature 1 sensor
15	Communication fault, main system (SCADA)	54	Motor protection function, 3 sec. limit	92	Calibration fault, (feedback) sensor
16	Other	55	Motor current protection activated (MCP)	93	Signal fault, sensor 2
17	Performance requirement cannot be met	56	Underload	94	Limit exceeded, sensor 1
18	Commanded alarm standby (trip)	57	Dry running	95	Limit exceeded, sensor 2
19	Diaphragm break (dosing pump)	58	Low flow	96	Setpoint signal outside range
20	Insulation resistance low	59	No flow	97	Signal fault, setpoint input
21	Too many starts per hour	64	Overtemperature	98	Signal fault, input for setpoint influence
22	Moisture switch alarm, digital	65	Motor temperature 1 (t_m or t_mo or t_mo1)	99	Signal fault, input for analog setpoint
23	Smart trim gap alarm	66	Temperature, control electronics (t_e)	104	Software shutdown
24	Vibration	67	Temperature too high, internal frequency converter module (t_m)	105	Electronic rectifier protection activated (ERP)
25	Setup conflict	68	External temperature/ water temperature (t_w)	106	Electronic inverter protection activated (EIP)
26	Load continues even if the motor has been switched off	69	Thermal relay 1 in motor (e.g. Klixon)	110	Skew load, electrical asymmetry
27	External motor protector activated (e.g. MP 204)	70	Thermal relay 2 in motor (e.g. thermistor)	111	Current asymmetry
28	Battery low	71	Motor temperature 2 (Pt100, t_mo2)	112	Cos ϕ too high
29	Turbine operation (impellers forced backwards)	72	Hardware fault, type 1	113	Cos ϕ too low
30	Change bearings (specific service information)	73	Hardware shutdown (HSD)	120	Auxiliary winding fault (single-phase motors)
31	Change varistor(s) (specific service information)	74	Internal supply voltage too high	121	Auxiliary winding current too high (single-phase motors)
32	Overvoltage	75	Internal supply voltage too low	122	Auxiliary winding current too low (single-phase motors)

Code	Description	Code	Description	Code	Description
123	Start capacitor, low (single-phase motors)	183	Signal fault, extra temperature sensor	216	Pilot pump alarm
124	Run capacitor, low (single phase motors)	184	Signal fault, general-purpose sensor	217	Alarm, general-purpose sensor high
144	Motor temperature 3 (Pt100, t_mo3)	185	Unknown sensor type	218	Alarm, general-purpose sensor low
145	Bearing temperature high (Pt100), in general or top bearing	186	Signal fault, power meter sensor	219	Pressure relief not adequate
146	Bearing temperature high (Pt100), middle bearing	187	Signal fault, energy meter	220	Fault, motor contactor feedback
147	Bearing temperature high (Pt100), bottom bearing	188	Signal fault, user-defined sensor	221	Fault, mixer contactor feedback
148	Motor bearing temperature high (Pt100) in drive end (DE)	190	Sensor limit 1 exceeded (e.g. alarm level in WW application)	222	Time for service, mixer
149	Motor bearing temperature high (Pt100) in non-drive end (NDE)	191	Sensor limit 2 exceeded (e.g. high level in WW application)	223	Maximum number of mixer starts per hour exceeded
152	Communication fault, add-on module	192	Sensor limit 3 exceeded (e.g. overflow level in WW application)	224	Pump fault (due to auxiliary component or general fault)
153	Fault, analog output	193	Sensor limit 4 exceeded	225	Communication fault, pump module
154	Communication fault, display	194	Sensor limit 5 exceeded	226	Communication fault, I/O module
155	Inrush fault	195	Sensor limit 6 exceeded	227	Combi event
156	Communication fault, internal frequency converter module	196	Operation with reduced efficiency	228	Not used
157	Real-time clock out of order	197	Operation with reduced pressure	229	Not used
158	Hardware circuit measurement fault	198	Operation with increased power consumption	230	Network alarm
159	CIM fault (Communication Interface Module)	199	Process out of range (monitoring/estimation/calculation/control)	231	Ethernet: No IP address from DHCP server
160	GSM modem, SIM card fault	200	Application alarm	232	Ethernet: Auto-disabled due to misuse
168	Signal fault, pressure sensor	201	External sensor input high	233	Ethernet: IP address conflict
169	Signal fault, flow sensor	202	External sensor input low	236	Pump 1 fault
170	Signal fault, water-in-oil (WIO) sensor	203	Alarm on all pumps	237	Pump 2 fault
171	Signal fault, moisture sensor	204	Inconsistency between sensors	238	Pump 3 fault
172	Signal fault, atmospheric pressure sensor	205	Level float switch sequence inconsistency	239	Pump 4 fault
173	Signal fault, rotor position sensor (Hall sensor)	206	Water shortage, level 1	240	Lubricate bearings (specific service information)
174	Signal fault, rotor origo sensor	207	Water leakage	241	Motor phase failure
175	Signal fault, temperature 2 sensor (t_mo2)	208	Cavitation	242	Automatic motor model recognition failed
176	Signal fault, temperature 3 sensor (t_mo3)	209	Non-return valve fault	243	Motor relay has been forced (manually operated/commanded)
177	Signal fault, Smart trim gap sensor	210	Overpressure	244	Fault, On/Off/Auto switch
178	Signal fault, vibration sensor	211	Underpressure	245	Pump continuous runtime too long
179	Signal fault, bearing temperature sensor (Pt100), general or top bearing	212	Diaphragm tank precharge pressure out of range	246	User-defined relay has been forced (manually operated/commanded)
180	Signal fault, bearing temperature sensor (Pt100), middle bearing	213	VFD not ready	247	Power-on notice (device/system has been switched off)
181	Signal fault, PTC sensor (short-circuited)	214	Water shortage, level 2	248	Fault, battery/UPS
182	Signal fault, bearing temperature sensor (Pt100), bottom bearing	215	Soft pressure build-up timeout		

11. Modbus telegrams and function codes

11.1 Modbus telegram overview

The maximum size of a Modbus RTU telegram is 256 bytes. Telegrams must be separated by a silent interval of at least 3.5 character times.

The standard Modbus RTU telegram format is shown in the table below:

Slave address	Function code	Data	CRC
1 byte	1 byte	0 to 252 bytes	2 bytes

A telegram starts with the slave address occupying one byte. Then comes a variable-size data field. For each telegram, a CRC is calculated and appended to the telegram (two bytes total). All bytes in the telegram, except for the CRC itself, are included in the check.

When using Modbus communication via a GSM call-up connection, the Modbus RTU telegram format is used.

When using Modbus communication via GPRS, the Modbus TCP telegram format is used. See section 6.9 *GPRS connection*.

The two formats have the address and "data" part of the telegram in common. Therefore, the examples in the following are equally valid for both connection types.

For Modbus RTU a two-byte CRC has to be added according to the Modbus specification.

Note

The Modbus data model states that registers numbered X are addressed in telegrams as $X - 1$, e.g. register 00104 (setpoint) is addressed as 00103 in a Modbus telegram.

11.2 Modbus function code overview

The supported function codes are shown in the table below:

Type	Code	Hex	Name
16-bit data (registers)	03	0x03	Read holding registers
	04	0x04	Read input registers
	06	0x06	Write single register
	16	0x10	Write multiple registers
Diagnostics	08	08	Diagnostics See section 11.7 Diagnostics (0x08) for subcodes.

Note

Reading or writing coils are not supported.

The same data are available in both holding registers and input registers, meaning that either function (0x03 or 0x04) can be used for reading data.

11.3 Read holding registers (0x03)

This function is used for reading holding registers from the slave.

The request telegram specifies the starting address (the address of the first register to be read) and the number of holding registers to read. In the telegram, register addresses start from zero, meaning that registers numbered 1-16 are addressed as 0-15.

The register data in the response message are packed two bytes per register. For each register, the first byte contains the high-order bits while the second byte contains the low-order bits.

Example of request from master to slave

Address	Function code	Start address HI	Start address LO	Quantity HI	Quantity LO
0x01	0x03	0x00	0x6B	0x00	0x03

In the request, the slave with address 1 is asked to deliver three contiguous registers starting from address 0x006b = 107 (meaning register 108).

Example of response from slave to master

Address	Function code	Byte count	Register 108 HI	Register 108 LO	Register 109 HI	Register 109 LO	Register 110 HI	Register 110 LO
0x01	0x03	0x06	0x00	0x01	0x00	0x01	0x00	0x01

In the response, the byte count is six since there are three registers of two bytes. All three registers hold the value of 0x0001.

11.4 Read input registers (0x04)

This function is used for reading input registers from the slave. Input registers are read-only registers by definition. The request telegram specifies the starting address (the address of the first register to be read) and the number of holding registers to read. In the telegram, registers are addressed starting from zero, meaning that registers numbered 1-16 are addressed as 0-15.

The register data in the response message are packed two bytes per register. For each register, the first byte contains the high-order bits while the second byte contains the low-order bits.

Example of request from master to slave

Address	Function code	Start address HI	Start address LO	Quantity HI	Quantity LO
0x01	0x04	0x10	0x10	0x00	0x03

In the request, the slave with address 1 is asked to deliver three contiguous registers starting from address 0x1010 = 4112 (meaning register 4113).

Example of response from slave to master

Address	Function code	Byte count	Register 4113 HI	Register 4113 LO	Register 4114 HI	Register 4114 LO	Register 4115 HI	Register 4115 LO
0x01	0x04	0x06	0x22	0x22	0x22	0x22	0x22	0x22

In the response, the byte count is six since there are three registers of two bytes. All three registers hold the value of 0x2222.

11.5 Write single register (0x06)

This function is used for writing a single holding register in the slave. The request telegram specifies the address of the register that is to be written. Register addresses start from zero, meaning that a register numbered 10 is addressed as 9.

The normal response is an echo of the request, indicating that the value was written.

Example of request from master to slave

Address	Function code	Address HI	Address LO	Value HI	Value LO
0x01	0x06	0x10	0x00	0xAF	0xFE

In the request, the slave with address 1 is asked to write the value 0xAFFE to the register at address 0x1000.

Example of response from slave to master

Address	Function code	Address HI	Address LO	Value HI	Value LO
0x01	0x06	0x10	0x00	0xAF	0xFE

The response is an echo of the request.

11.6 Write multiple registers (0x10)

This function is used for writing a block of contiguous holding registers in the slave. Register addresses start from zero, meaning that a register numbered 100 is addressed as 99.

Example of request from master to slave

Address	Function code	Start address HI	Start address LO	Quantity HI	Quantity LO	Byte count	Register 33 HI	Register 33 LO	Register 34 HI	Register 34 LO
0x01	0x10	0x00	0x20	0x00	0x02	0x04	0x00	0x01	0xB0	0xB0

In the request, the slave with address 1 is asked to write the value 0x0001 to the register at address 0x0020 and the value 0xB0B0 to the register at address 0x0021.

Example of response from slave to master

Address	Function code	Start address HI	Start address LO	Quantity written HI	Quantity written LO
0x01	0x10	0x00	0x20	0x00	0x02

The response returns the function code, starting address and quantity of registers written.

11.7 Diagnostics (0x08)

This function provides a test for checking the communication system between the master and the Grundfos slave. It contains a single-byte subcode to identify the test to be performed.

Subcode	Name
0x00	Return query data <i>Data in this request are to be echoed in the response. The response must be identical to the request, so this function is often used to verify Modbus communication.</i>
0x01	Restart communications <i>All communications counters are cleared, and the device is restarted.</i>
0x02	Return diagnostics register <i>Returns the 16-bit diagnostics register. See section 11.8 Diagnostics register interpretation.</i>
0x04	Force Listen Only <i>Forces the device into Listen-Only mode. This effectively mutes the device, making it unable to communicate on the network. To bring the device back to normal mode, a "Restart communications" command (code 0x08, subcode 0x01) must be issued.</i>
0x0A	Clear counters and diagnostics register <i>Clears all counters and the diagnostics register. (These are also cleared on power-up/restart).</i>
0x0B	Return bus message count <i>Returns the number of messages detected by the slave.</i>
0x0C	Return bus CRC error count <i>Returns the number of CRC errors in the slave.</i>
0x0D	Return bus exception count <i>Returns the number of Modbus exception responses that the slave has transmitted.</i>
0x0E	Return slave message count <i>Returns the number of messages that the slave has processed.</i>
0x0F	Return slave no response count <i>Returns the number of messages for which the slave has sent no response.</i>
0x12	Return bus character overrun count <i>Returns the number of overruns in the slave.</i>
0x14	Clear overrun counter <i>Clears the overrun counter. (This is also cleared on power-up/restart).</i>

Example of request from master to slave

Address	Function code	Subcode	Data	Data
0x01	0x08	0x00	0xAB	0xCD

The response is identical to the request.

Example of response from slave to master

Address	Function code	Subcode	Data	Data
0x01	0x08	0x00	0xAB	0xCD

11.8 Diagnostics register interpretation

The diagnostics register is interpreted as follows:

Bit	Description
0	Internal communication failure (with the Grundfos CU 361).
1	EEPROM self-test failed (test is carried out when the system is booted).
2	Grundfos CU 361 not supported.
3	RESERVED
4	RESERVED
5	RESERVED
6	RESERVED
7	RESERVED
8	RESERVED
9	RESERVED
10	RESERVED
11	RESERVED
12	RESERVED
13	RESERVED
14	RESERVED
15	RESERVED

A bit value of 1 means true, unless otherwise specified. The diagnostics register is read using function code 0x08 and subcode 0x02.

12. Application example

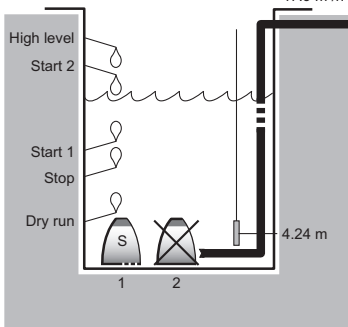
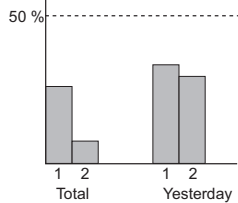
Pit operation	Pit status	Pump 1	Pump 2	Setup	Event log	Hour log	Data log
 Alarm/warning Grey Pump OK. Yellow Pump warning. Red Pump alarm (device alarm or monitoring fault). Run/stop Grey Pump not running. Green Pump running. Manual S Switch. D Display. R Remote. Setup: Opens a display for configuration of all the control levels. Event log: Opens a display for viewing the SCADA event log. Hour log: Opens a display for viewing the hourly logged values 3 days backwards. Data log: Opens a display for viewing the configurable data log series. Crossover: The pump has been disabled.							
Pump 1 Operating mode: Start from switch Average flow XXX.X m³/h Latest flow XXXXX m³/h Starts total XXXXX Starts yesterday XXXXX Starts today XXXXX Starts per hour XXXXX/h Opr. time total XXXXX/h : XX min. Opr. time yesterday XXXXX/h : XX min. Opr. time today XXXXX/h : XX min. Latest opr. time XXXXX/h : XX min. Time to service XXXXX/h	Pit status Water level XX.XX m Pit depth XX.XX m Actual flow XXX.XX m³/h Average flow XXX.XX m³/h Power XXX.XX kW Energy total XXXXXX kWh Energy yesterday XXXXXX kWh Energy today XXXXXX kWh Specific energy XX.XXX kWh/m³ Operating time XXXXX h : XX min. Volume total XXXXX m³ Volume yesterday XXXXX.X m³ Volume today XXXXX.X m³ Mixer starts per hour XXX.X /h	Pit operation Operating mode: Interlock from SCADA Auto Interlock Alarm ack. Custom relay ☐ ON ☒ Off Time Feb 26 2008 08.20 Set time..					
Motor Temperature XXX °C Actual current XXX.X A Latest current XXX.X A Water in oil XX.X %	Overflow Total volume XXXXX m³ Overflow time XXXXX h Number of overflows XXXXX Overflow volume yesterday XXXXX m³ Overflow time yesterday XX h : XX min. No. of overflows yesterday XXX Overflow volume today XXXXX m³ Overflow time today XX h : XX min. No. of overflows today XXX	☐ Stop ☒ Start ☐ Auto					
Remote pump control ☐ Stop ☒ Start ☐ Auto							
Active alarms/warnings Alarms None Warnings Water-in-oil sensor signal fault	Opr. time, simultaneous opr. of two pumps 						
	Active alarms/warnings Alarms None Warnings None						

Fig. 15 Application example

12.1 Adaptation of pit graphics to installation values

- Pump object graphics (the shown register addresses are for pump 1):
 - Presence (pump object drawn or not)
Pump#Status.Presence (register 00401, bit 0)
 - Disabled (cross marking) Pump#Status.Disabled (register 00401, bit 11)
 - Pumping mode (Running = green, Stopped = grey)
Pump#Status.Running (register 00401, bit 1).
- Pump top colour (the shown register addresses are for pump 1):
 - Red if an alarm is present in Pump#Status.Alarm (register 00401, bit 4) or a monitoring fault (fault in auxiliary device) in Pump#Status.MonitoringFault (register 00401, bit 2)
 - Yellow if a warning is present in Pump#Status.Warning (register 00401, bit 3)
 - Grey if everything is OK for the pump in question.
- Pump control source (the shown register addresses are for pump 1): Pump#ControlSource (register 00402 [enum]). Letter marking of pump icon:
 - Auto = no marking
 - Switch = "S"
 - Display = "D"
 - Remote = "R".
- Number of float switches: NumberOfFloatSwitches (register 00217).
- Function of float switches 1 to 5:
 - FloatSwitch1Function (register 00219 [enum])
 - FloatSwitch2Function (register 00220 [enum])
 - FloatSwitch3Function (register 00221 [enum])
 - FloatSwitch4Function (register 00222 [enum])
 - FloatSwitch5Function (register 00223 [enum]).
- Displayed switch position:
 - Switch on (1) = up
 - Switch off (0) = down.
- Value of float switches 1 to 5: FloatSwitchesStatus (register 00218).
- Type of level and flow measurements: PitSensors (register 00224 [enum]).
- Water level: PitWaterLevel (register 00301 [0.01 m]) shown as a level sensor value and as a drawing of the water surface. If a level sensor is not present, the level can be expressed relative to the position of the installed float switches: PitSwitchWaterLevel (register 00302 [enum]).
- Flow value:
 - PitFlowOut (register 00306 [0.1 l/s]) or
 - PitAverageFlowOut (register 00307 [0.1 l/s]).

12.2 Main status

12.2.1 Pit operation display

Note

Before trying to operate the CU 361 control unit, remember to write the ScadaPinCode (register 00109) if PIN code protection has been enabled.

- Operating mode: OperatingMode (register 00203 [enum]).
- The "Interlock" button will issue the PitControl.InterlockPit (register 00101, bit 3) command, which brings the pit into operating mode "Interlocked", and the "Auto" button will issue the PitControl.AutoPit (register 00101, bit 4) command, which brings it back into one of the automation modes.
- The "Alarm Ack" button will issue the PitControl.ResetAlarm (register 00101, bit 0) command, which will clear any alarm/warning indication (not logs) which does not represent a present alarm/warning condition, and will make the system assume automation control without any auto-acknowledgement delay.
- The "Custom relay" buttons are "radio buttons". Selecting "On" will issue the value 1 to data item SetCustomRelay (register 00102), and selecting "Off" will issue the value 0.

- Time (real-time clock in the CU 361 control unit):
 - Reading and displaying the time is done by using RealTimeClockHI/LO (register 00228/00229 [unix time]) or RtcSecond (register 00230), RtcMinute (register 00231), RtcHour (register 00232), RtcDay (register 00233), RtcMonth (register 00234), RtcYear (register 00235) if this time format is preferred.
 - The "Set time..." button opens a dialogue that can write the data item SetRealTimeClockHI/LO (register 00112/00113 [unix time]).

12.2.2 Pit status display

- Water level: PitWaterLevel (register 00301 [0.01 m]).
- Pit depth: PitDepth (register 00303 [0.01 m]).
- Actual flow: PitFlowOut (register 00306 [0.1 l/s]).
- Average flow: PitAverageFlowOut (register 00307).
- Total power consumption: PitPowerHI/LO (register 00308/00309 [1 W]).
- Total energy consumption: PitEnergyHI/LO (register 00310/00311 [0.1 kWh]).
- Energy consumption yesterday: PitEnergyYesterday (register 00312 [0.1 kWh]).
- Energy consumption today: PitEnergyToday (register 00313 [0.1 kWh]).
- Total pumping efficiency: PitSpecificEnergy (register 00314 [1 Wh/m³]).
- Total operating time: PitOperatingTimeHI/LO (register 00329/00330 [1 min.]).
- Total pumped volume: PitPumpedVolumeHI/LO (register 00315/00316 [0.1 m³]).
- Pumped volume yesterday: PitPumpedVolumeYesterday (register 00317 [0.1 m³]).
- Pumped volume today: PitPumpedVolumeToday (register 00318 [0.1 m³]).
- Number of mixer starts per hour: PitMixerStartsPerHour (register 00319).
- Total overflow volume: PitOverflowVolume (register 00320 [0.1 m³]).
- Overflow volume yesterday (24 h): PitOverflowVolumeYesterday (register 00321 [0.1 m³]).
- Overflow volume today: PitOverflowVolumeToday (register 00322 [0.1 m³]).
- Total overflow time: PitOverflowTime (register 00323 [1 min.]).
- Overflow time yesterday (24 h): PitOverflowTimeYesterday (register 00324 [1 min.]).
- Overflow time today (24 h): PitOverflowTimeToday (register 00325 [1 min.]).
- Total number of overflows: PitOverflowCounter (register 00326).
- Number of overflows yesterday (24 h): PitOverflowCounterYesterday (register 00327).
- Number of overflows today (24 h): PitOverflowCounterToday (register 00328).
- One-pump operating time: (Pump1OprTimeHI/LO + Pump2OprTimeHI/LO – Pit2PumpsOperatingTimeHI/LO).
- Two-pump operating time (two pumps operating simultaneously): Pit2PumpsOperatingTimeHI/LO (register 00331/00332 [1 min.]).
- One-pump operating time yesterday (24 h): (Pump1OprTimeYesterday + Pump2OprTimeYesterday – Pit2PumpsOprTimeYesterday).
- Two-pump operating time yesterday (two pumps operating simultaneously): Pit2PumpsOperatingTimeYesterday (register 00333 [1 min.]).
- Calculation of relative operating times:
 - 1 pump = (Pump1OprTimeHI/LO + Pump2OprTimeHI/LO – Pit2PumpsOperatingTimeHI/LO) / PitOperatingTimeHI/LO (register 00329/00330)
 - 2 pumps = Pit2PumpsOperatingTimeHI/LO / PitOperatingTimeHI/LO.

- Active alarms and warnings:
 - PitAlarms1 (register 00210 [bits])
 - PitAlarms2 (register 00211 [bits])
 - PitAlarms3 (register 00212 [bits])
 - PitWarnings1 (register 00213 [bits])
 - PitWarnings2 (register 00214 [bits])
 - PitWarnings3 (register 00215 [bits]).

12.2.3 Pump status display

The data item registers mentioned below are for pump 1. Adding 50 to the register addresses will give you the equivalent register addresses for pump 2.

- Operating mode (Started, Stopped): Pump1Status.Running (register 00401, bit 1).
- Control source (Auto, Switch, Display, Remote): Pump1ControlSource (register 00402 [enum]).

Note

The above information can be combined in a text like "Operating mode" from "Control source".

- Average flow: Pump1Flow (register 00416 [0.1 l/s]).
- Latest measured flow: Pump1LatestFlow (register 00417 [0.1 l/s]).
- Total number of pump starts: Pump1StartCounterHI/LO (register 00411/00412).
- Number of pump starts yesterday (24 h): Pump1StartCounterYesterday (register 00413).
- Number of pump starts today: Pump1StartCounterToday (register 00414).
- Number of pump starts per hour: Pump1StartsPerHour (register 00415).
- Total operating time: Pump1OprTimeHI/LO (register 00404/00405 [1 min.]).
- Operating time yesterday (24 h): Pump1OprTimeYesterday (register 00408 [1 min.]).
- Operating time today: Pump1OprTimeToday (register 00409 [1 min.]).
- Latest operating time: Pump1LatestOprTime (register 00410 [1 s]).
- Time to service: Pump1TimeToServiceHI/LO (register 00406/00407 [1 min.]).
- Motor temperature: Pump1MotorTemperature1 (register 00429 [1 °C]).
- Motor current:
 - Pump1Current (register 00418 [0.1 A])
 - Pump1LatestCurrent (register 00419 [0.1 A]).
- Motor, water in oil: Pump1WaterInOil (register 00422 [0.1 %]).
- Commanding the pumps (Manual from Remote):
 - Stop will issue the value PitPump1Control (register 00103 [enum]) = 2, which brings the pump into operating mode Stop from Remote.
 - Start will issue the value PitPump1Control (register 00103 [enum]) = 1, which brings the pump into operating mode Start from Remote.
 - Auto will issue the value PitPump1Control (register 00103 [enum]) = 0, which brings the pump back into its previous state.
- See fig. 16 for logic and priority for the pump control, and note that the control sources Switch and Display have higher priority than Remote.

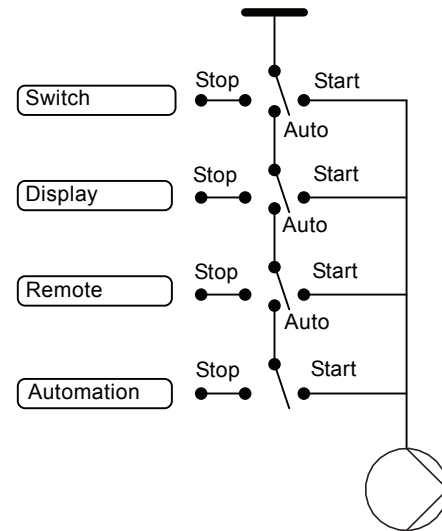


Fig. 16 Logic and priority for the pump control

Note

Before trying to operate the pumps, remember to write the ScadaPinCode (register 00109) if PIN code protection has been enabled.

- Active alarms and warnings:
 - Pump1Alarms1 (register 00423 [bits])
 - Pump1Alarms2 (register 00424 [bits])
 - Pump1Alarms3 (register 00425 [bits])
 - Pump1Warnings1 (register 00426 [bits])
 - Pump1Warnings2 (register 00427 [bits])
 - Pump1Warnings3 (register 00428 [bits]).

Display bar

The blue bar at the top of the screen is used to open and close specific displays that can show specific data and change settings of the pit control system.

The descriptions below refer to fig. 15.

- The "Pit operation" button opens the "Pit operation" display.
- The "Pit status" button opens the "Pit status" display.
- The "Pump 1" and "Pump 2" buttons open the "Pump 1" and "Pump 2" displays.
- The "Setup" button opens the display for showing and changing all the pump control levels. It might look as shown below.

Pumping control levels

Overflow level	XXX cm	Cancel	Update
High level	XXX cm		
Alarm level	XXX cm		
Dry-running level	XXX cm		
Foam-draining level	XXX cm		
	Pump 1	Pump 2	
Start level	XXX cm	XXX cm	
Stop level	XXX cm	XXX cm	

- Overflow level: SetOverflowLevel (register 00121 [0.01 m]).
- High level: SetHighLevel (register 00122 [0.01 m]).
- Alarm level: SetAlarmLevel (register 00123 [0.01 m]).
- Dry-running level: SetDryRunningLevel (register 00124 [0.01 m]).
- Foam-draining level: SetFoamDrainingLevel (register 00125 [0.01 m]).
- Start levels for pumps 1 and 2:
 - SetStartLevelPump1 (register 00126 [0.01 m])
 - SetStartLevelPump2 (register 00128 [0.01 m]).
- Stop levels for pumps 1 and 2:
 - SetStopLevelPump1 (register 00127 [0.01 m])
 - SetStopLevelPump2 (register 00129 [0.01 m]).

These registers only reflect the actual values if the WriteSetup.ReadWriteSeparation (register 00006) bit is set to 0. Otherwise reading back the actual values has to take place via the corresponding read-only registers, e.g. OverflowLevel (register 00240).

Note

Before trying to change the settings, remember to write the ScadaPinCode (register 00109) if PIN code protection has been enabled.

Note

- The "Event log" button opens the display for showing a scrollable list of event records (alarms and warnings).
The event log in the CU 361 contains the 50 latest events with the newest one at the top.

Each record takes up seven registers and has the following format:

<ID> <Code> <Description> <Source> <Type> <Time stamp>

The complete event log takes up $7 \times 50 = 350$ registers and is located in the register area register 06001 to 06351.

An [Event log](#) example is shown on page 57.

Event log

ID	Code	Description	Source	Type	Time
341	192	Overflow	System	Alarm appearing	05-08-2008 09:25
342	192	Overflow	System	Alarm disappearing	05-08-2008 11:09
343	222	Time for service, mixer	Mixer	Warning appearing	07-08-2008 02:38
344	6	Motor insulation resistance low	Pump 2	Warning appearing	11-08-2008 08:24

Note The time stamp is in Unix time format. In the display example it has been converted to a human-readable format.

Hour log

- The "Hour log" button opens the display for showing the hour log. The table below illustrates the structure of the data in the Modbus registers and a way of visualising them.

Data	Hour						Registers
	1	2	3	...	71	72	
Pit overflow time [min.]	0	4	6		0	0	02001-02072
Number of pit overflows	0	1	3		0	0	02073-02144
Overflow volume [0.1 m ³]	0	12	34		0	0	02145-02216
Specific energy [Wh/m ³]	240	262	198		308	287	02217-02288
Pumped volume [m ³]	67	69	72		45	23	02289-02360
Energy consumption [0.1 kWh]	342	456	514		178	123	02361-02432
Operating time (two pumps operating simultaneously) [min.]	8	20	48		0	4	02433-02504
Pump 1, operating time [min.]	23	56	60		14	12	02793-02864
Pump 1, number of starts	4	1	1		4	3	02865-02936
Pump 1, average flow [0.1 l/s]	452	468	458		433	446	02937-03008
Pump 1, average current [0.1 A]	252	248	241		240	242	03009-03080
Pump 2, operating time [min.]	21	52	63		15	11	03081-03152
Pump 2, number of starts	7	2	1		2	3	03153-03224
Pump 2, average flow [0.1 l/s]	458	451	471		438	444	03225-03296
Pump 2, average current [0.1 A]	250	239	240		229	240	03297-03368

Data Log

- The "Data log" button opens the display for showing the configurable data log.

The illustrations in fig. 17 show a way of visualising the pit water level, motor current for pump 1 and motor current for pump 2.

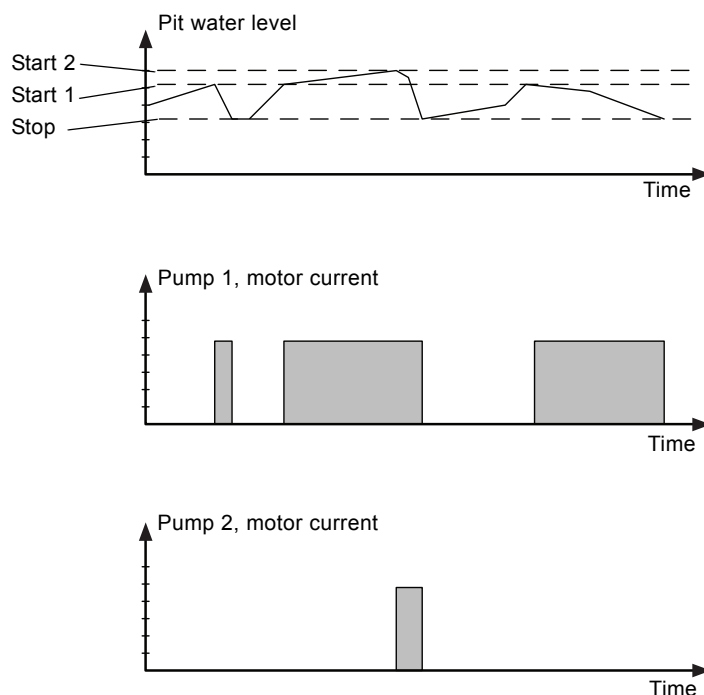


Fig. 17 Data logging

13. Modbus telegram examples

When using Modbus communication via a GSM call-up connection, the Modbus RTU telegram format is used.

When using Modbus communication via GPRS, the Modbus TCP telegram format is used. See section 6.9 *GPRS connection*.

The two formats have the address and "data" part of the telegram in common. Therefore, the examples in the following are equally valid for both connection types.

For Modbus RTU a two-byte CRC has to be added according to the Modbus specification.

Note

The Modbus data model states that registers numbered X are addressed in telegrams as X - 1, e.g. register 00104 (setpoint) is addressed as 00103 in a Modbus telegram.

13.1 Diagnostics: return query data

This function is useful to ensure that the communication path and slave configuration are correct. It will echo the request in the response.

In the example, slave address 0x01 is used.

Request from master to slave

Field	Value	Description
Slave address	0x01	–
Function code	0x08	Diagnostics
Subcode	0x00	Echo request
Data	0xAB	Test data
Data	0xCD	Test data

Response from slave to master

Field	Value	Description
Slave address	0x01	–
Function code	0x08	Diagnostics
Subcode	0x00	Echo request
Data	0xAB	Test data
Data	0xCD	Test data

If there is no response from the slave, refer to section 8.2 *Modbus GSM/GPRS communication faults*.

13.2 Reading the device configuration register block

This section shows how to read the Device Config register block (a total of four registers).

In the example, slave address 0x01 is used.

Request from master to slave

Field	Value	Description
Slave address	0x01	–
Function code	0x04	Read input registers
Start address HI	0x00	Start address
Start address LO	0x00	= 0x0001
Quantity HI	0x00	Number of registers
Quantity LO	0x04	= 0x0004

Response from slave to master

Field	Value	Description
Slave address	0x01	–
Function code	0x04	Read input registers
Byte count	0x08	8 bytes follow
00001 HI	0x0A	SlaveMinimumReplyDelay
00001 LO	0x00	= 0x000A (10 ms)
00002 HI	0x00	RegisterOffset
00002 LO	0x00	= 0x0000 (no offset)
00003 HI	0x00	Reserved value
00003 LO	0x00	= 0x0000
00004 HI	0x00	ModbusBitRate
00004 LO	0x04	= 0x0004 (19200, software-defined)

If there is no response from the slave, refer to section 8.2 *Modbus GSM/GPRS communication faults*.

13.3 Reading the pit water level

This section shows how to read and interpret the water level of the pit.

In the example, slave address 0x01 is used.

Request from master to slave

Field	Value	Description
Slave address	0x01	–
Function code	0x04	Read input registers
Start address HI	0x01	Start address (00301)
Start address LO	0x2C	= 0x012D
Quantity HI	0x00	Number of registers
Quantity LO	0x01	= 0x0001

Response from slave to master

Field	Value	Description
Slave address	0x01	–
Function code	0x04	Read input registers
Byte count	0x02	2 bytes follow
00301 HI	0x00	Pit water level
00301 LO	0xDC	= 0x00DC (220)

A pit water level value of 220 [0.01 m] equals a water level of 2.20 metres.

If there is no response from the slave, refer to section 8.2 *Modbus GSM/GPRS communication faults*.

13.4 Reading the pit alarms

This section shows how to read and interpret the three alarm registers of the pit. The pit alarms start at Modbus register address 209 = 0x00D1.

In the example, slave address 0x01 is used.

Request from master to slave

Field	Value	Description
Slave address	0x01	–
Function code	0x04	Read input registers
Start address HI	0x00	Start address (00209) = 0x00D1
Start address LO	0xD0	
Quantity HI	0x00	Number of registers = 0x0003
Quantity LO	0x03	

Response from slave to master

Field	Value	Description
Slave address	0x01	–
Function code	0x04	Read input registers
Byte count	0x06	6 bytes follow
00209 HI	0x00	Pit alarms 1
00209 LO	0x08	
00210 HI	0x00	Pit alarms 2
00210 LO	0x00	
00211 HI	0x00	Pit alarms 3
00211 LO	0x00	

If there is no response from the slave, refer to section [8.2 Modbus GSM/GPRS communication faults](#).

When reading the three pit alarm registers, the following data becomes available:

Pit alarms 1 = 0b 0000 0000 0000 1000

Pit alarms 2 = 0b 0000 0000 0000 0000

Pit alarms 3 = 0b 0000 0000 0000 0000.

As seen from the alarms table, the bit for dry-running alarm is set in pit alarms 1.

13.5 Setting pit auto mode

This section shows how to set "Auto" mode in the CU 361.

In the example, slave address 0x01 is used. Note that the register is reset by the CIM 250 when the command has been acknowledged. The value is only triggered on rising edge.

The register on address 00101 is set to the following:

Bit	Description
0	0 (do not reset)
1	0 (do not reset alarms)
2	0 (do not reset history)
3	0 (do not reset event log)
4	0 (do not interlock the pit)
5	1 (set pit to "Auto" mode)

Hence the value to set is 0b000000000100000 = 0x0020.

Request from master to slave

Field	Value	Description
Slave address	0x01	–
Function code	0x06	Write single register
Start address HI	0x00	ControlRegister address = 00101 (0x0065)
Start address LO	0x64	
Value HI	0x00	ControlRegister value = 32 (0x0020)
Value LO	0x20	

Response from slave to master

Field	Value	Description
Slave address	0x01	–
Function code	0x06	Write single register
Start address HI	0x00	ControlRegister address = 00101 (0x0065)
Start address LO	0x64	
Value HI	0x00	ControlRegister value = 32 (0x0020)
Value LO	0x03	

If there is no response from the slave, refer to section [8.2 Modbus GSM/GPRS communication faults](#).

Note Writing control bits that are mutual exclusive may lead to unpredictable results.

13.6 Interlocking the pit

This shows how to interlock the CU 361.

In the example, slave address 0x01 is used. Note that the register is reset by the CIM 250 when the command has been acknowledged. The value is only triggered on rising edge.

The register on address 00101 is set to the following:

Bit	Description
0	0 (do not reset)
1	0 (do not reset alarms)
2	0 (do not reset history)
3	0 (do not reset event log)
4	1 (interlock the pit)
5	0 (set pit in "Auto" mode)

Hence the value to set is 0b00000000010000 = decimal 16 = 0x0010.

Request from master to slave

Field	Value	Description
Slave address	0x01	–
Function code	0x06	Write single register
Start address HI	0x00	ControlRegister address = 00101 (0x0065)
Start address LO	0x64	
Value HI	0x00	ControlRegister value = 16 (0x0010)
Value LO	0x10	

Response from slave to master

Field	Value	Description
Slave address	0x01	–
Function code	0x06	Write single register
Start address HI	0x00	ControlRegister address = 00101 (0x0065)
Start address LO	0x64	
Value HI	0x00	ControlRegister value = 16 (0x0010)
Value LO	0x10	

If there is no response from the slave, refer to section [8.2 Modbus GSM/GPRS communication faults](#).

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